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López Cristóbal (U.). **Los "gusanos blancos" de las sementeras.** [The White Grubs of Seed Fields.]—*Bol. Lab. Zool. agríc. Fac. Agron. Univ. nac. La Plata* no. 6 4 pp., 5 figs., 6 refs., multigraph. La Plata, 1941.

In various parts of Argentina the larvae of Lamellicorns injure wheat by feeding on the roots. Of those received by the author from wheat-growing districts in La Plata, the Dynastids, *Dyscinetus gagates*, Burm., *Euetheola humilis*, Burm., and *Diloboderus abderus*, Sturm, represented 60, 24 and 16 per cent., respectively. Since *Dyscinetus* was the most numerous, investigations on its bionomics were begun in the laboratory in October 1939. They showed that the injury is caused by the adults, and not by the larvae. The adults emerged from September to early November and fed voraciously at the root collar of wheat and oats. In the laboratory, one beetle killed 14 wheat plants three months old in a day. The adults lived for up to 3 months and the females oviposited about a month after emergence. The greatest number of eggs deposited by a single female was 16, but examination of the ovaries indicated a possible maximum of 40. The eggs were laid singly or in pairs, at a depth of about 2 ins. in the soil, and hatched in about 20 days. The larvae fed on humus and starved when given only calcined soil and fresh rootlets. They occur mostly at the surface of the ground in places rich in humus. After about 2 months they entered the prepupal stage and overwintered at depths of 4–6 ins. These prepupae are thought occasionally to feed and alter their position in the soil. Pupation occurs in the spring, and the adults emerge about a month later. The eggs are destroyed by a Tyroglyphid mite, and the larvae by mites, Nematodes and the adults of *Calosoma* sp.

Contact dust poisons could be applied against the adults, but the best method of control is early ploughing to a depth of about 6 ins., followed by disking, which kills the prepupae in the soil.

de Fluiter (H. J.). **Waarnemingen omtrent engerlingen (oerets) en hun bestrijding in *Hevea*-aanplantingen.** [Observations on White Grubs and their Control in *Hevea* Plantations.]—*Arch. Rubbercult.* **25** no. 2 pp. 167–264, 5 pls., 1 graph, 1 map, 10 figs., 29 refs. Soerabaia, 1941; also as *Meded. besoek. Proefst.*, Djember. (With a Summary in English.)

The Lamellicorn larvae that occur in the plantations of rubber (*Hevea*) at the Besoeki Experiment Station, Java, include some, such as Cetoniids, that feed only on decaying vegetable matter, some, such as Rutelids of the genus *Anomala*, especially *A.* (*Euchlora*) *viridis*, F., and the Dynastid, *Xylotrupes gideon*, L., that feed on living roots of rubber only in the absence of decaying material, and a group comprising the Melolonthids, *Lepidiota stigma*, F., *Leucopholis rorida*, F., *Lachnosterna* (*Holotrichia*) *leucophthalma*, Wied., *L.* (*H.*) *javana*, Brenske, and *Psilopholis grandis*, Lap., which feed preferably on the living roots. Keys are given to the larvae of the last two groups and to those of the Dynastids, including *X. gideon*, that feed on decaying material in the plantations, followed by notes on the life-history and control of the former.

The author's observations on *Leucopholis rorida* and *Lepidiota stigma* largely confirmed those of Leefmans [*R.A.E.*, A **4** 82]. *L. stigma* was the commonest and most harmful of all the Lamellicorns at the Station and was numerous in loose sandy soils. The adults emerge during October and November, in the first half of the west monsoon (rainy season). The females lay their eggs in the soil, either singly or in clusters and prefer ground covered by green manure plants or mulch to land that has been clean weeded. The egg, larval and pupal stages lasted about 15 days, 9 months and 26–38 days, respectively. The bionomics of *Leucopholis rorida* were similar, but soil treated with stable manure seemed particularly attractive for oviposition. The greatest injury to rubber occurred where it was grown in land that had just been weeded. The adults of *Lachnosterna* spp. also emerge during the first half of the wet season.

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L. leucophthalma is the more injurious, and observations by Arens [**8** 139] on its bionomics are recapitulated. *L. javana* was injurious mostly in nurseries, but was not common. The prepupal stage lasted about 15 days and occurred in August. The pupal stage lasted 24 days, and the adults emerged in October. *Psilopholis grandis* was recorded from two rubber nurseries. Characters distinguishing it from the closely related *P. vestita*, Sharp, which occurs in Malaya [*cf.* **28** 301], Sumatra and Borneo, are given. Their bionomics are probably very similar. The adults of *P. grandis* emerged in the second half of the rainy season, and the prepupal and pupal stages lasted 10–48 and 22 days, respectively. The larvae preferred to feed on the smaller roots of unhealthy plants and rarely attacked healthy buddings with an abundant flow of latex. The occasionally injurious species are dealt with more briefly and the results of breeding experiments with the 18 species recorded are shown in a table.

Control is dealt with at some length [*cf.* **4** 82]. The eggs, young larvae and pupae are not accessible to direct control measures ; hand-collection is effective against the older larvae but difficult to carry out, while collection of the adults gives considerable control of *Leucopholis rorida*. Soil fumigation with carbon bisulphide, either undiluted or in the form of an emulsion [**25** 599], is effective but expensive, while clean cultivation and the avoidance of ground cover during the flight period reduced oviposition. The larval population was considerably reduced in one experiment by flooding the ground for a week and then ploughing it.

The most important natural enemies of Lamellicorn larvae are Scoliid parasites, but they are rare in rubber plantations in Java owing to the infrequency of the flowering plants frequented by the adults. The three species taken and 16 recorded in the literature from various parts of the Netherlands Indies as parasites of some of the Lamellicorn larvae found at the Station are shown in tables. The frequency of these parasites might be increased by encouraging the growth of wild plants that attract the adults.

GADD (C. H.). **The Control of Tea Tortrix by its Parasite** *Macrocentrus homonae.—Tea Quart.* **14** pt. 3 pp. 93–97, 1 fig., 3 refs. Talawakelle, 1941.

Prior to 1935, *Homona coffearia*, Nietn., was regarded as one of the most important pests of tea bushes in Ceylon, and compulsory collection of egg masses was the chief means of control [*cf. R.A.E.*, A **25** 586]. In 1935 and 1936, small consignments of *Macrocentrus homonae*, Nixon, were received from Java [*cf.* **26** 337, 639] and liberated against it. The introduction was successful, and the parasite increased steadily [*cf.* **29** 174]. Larvae of *Homona* have been collected about four times a month from June 1935 to June 1941 in the area in which *Macrocentrus* was liberated ; the average number per collection for each month is shown in graphs, together with the percentage parasitised by any insect in 1935–36 and by *Macrocentrus* only in 1937–41. It is evident from the figures that a great decrease in population of *H. coffearia* has been coincident with the establishment of the parasite and that the percentage of larvae parasitised is high even when the larvae are scarce. The gradual reduction of the Tortricid from a major to a minor pest of tea thus appears to be due to the efficiency of this Braconid.

HWANG (Shui-lwen). **A preliminary Report on the chemical Composition of Yam Bean (*Pachyrhizus erosus* Urban), a new Rotenone bearing Plant.** [*In Chinese.*]—*Kwangsi Agric.* **2** no. 4 pp. 269–280, 8 refs. [? Kweilin] 1941. (With a Summary in English.)

The following is substantially the author's summary. The portion of the seed of yam bean (*Pachyrhizus erosus*) that has the highest insecticidal property

is soluble in methyl and ethyl alcohol, acetone, chloroform and ether, and gives positive reactions with the Gross-Smith and Durham tests. Thus one more genus is added to the list of rotenone-bearing plants. Two pure crystalline compounds were isolated and found inactive as insecticides. No further investigation was made on these compounds.

On the application of the Gross-Smith test as modified by Goodhue for the estimation of the insecticidal principles, the highest colour intensity was not given by the highest concentrations of the acetone extracts of the ground seed. The highest value was obtained only when the acetone solution was equivalent to less than 5·3 mg. ground seed per cc. By using a standardised procedure, the Gross-Smith value of 12 samples collected from five different provinces in China was determined. A sample from Kweichow gave the highest value (1·01 per cent.), and three from Kwangsi gave the lowest (0·56–0·61 per cent.). The crude protein content of these samples ranged from 30·01 to 40·81 per cent., and the fat content from 23·35 to 32·94 per cent. The Gross-Smith value of oil expressed from one of the samples from Kweichow was 0·51 per cent., which suggests that this oil may possess strong insecticidal properties when used as an emulsion. It was found that *P. erosus* differs from other rotenone-bearing plants in that the Gross-Smith value of samples of ground seeds subjected to continuous extraction with ether for 12 hours was reduced by only 16–47 per cent.

CORBETT (C. F.). **Plantas ictiotóxicas. Farmacologia da rotenona.** [Fish-poison Plants. The Pharmacology of Rotenone.]—*Monogr. Fac. Med. Univ. S. Paulo* no. 1 157 pp., 24 pls. (7 fldg.) 91 refs. São Paulo, 1940. (With a Summary in English.) [Recd. 1942.]

In the first part (pp. 7–73), the author reviews the history of the use of plants as fish poisons, mentioning their employment as insecticides by the Chinese. He records the botanical families and genera concerned, gives a list of the popular and scientific names of those occurring in various parts of the world and enumerates the many plants known in Brazil by the name of timbó. He then discusses from the literature the active principles of the plants, particularly rotenone, and deals with extraction and standardisation. In the second part (pp. 77–148), he describes experiments on the toxicity of rotenone to animals other than insects.

[EFIMOV (A. L.) & KAZAS (I. A.).] **Ефимов (А. Л.) и Казас (И. А.). Insecticides and Fungicides.** [*In Russian.*]—Demy 8vo, 240 pp., 26 refs. Moscow, Sel'khozgiz, 1940. Price 4 *rub.* [Recd. 1942.]

Over 60 chemicals are now produced in the Russian Union for the protection of plants and plant products from injurious insects and fungi, and the properties and uses of the more important of them are reviewed in this book, which is intended for use in agricultural colleges. The first section contains general information on the classification and toxicity of poisons, methods of application and the physical and chemical properties that dusts, sprays and fumigants should possess to be effective against Arthropods and fungi. The second section (pp. 28–119) deals with stomach and contact insecticides ; it contains a chapter on arsenicals by P. V. Popov and others on compounds of fluorine and barium, sulphur and its compounds, soaps, oils, and insecticides of vegetable origin. Fumigants for the treatment of plants and stored products are dealt with in the third section (pp. 120–166) and fungicides in the fourth. The subjects discussed under each substance include its production, properties, methods of use, and action on insects or fungi, plants and man and domestic animals. Precautions to be adopted during the transport, storage and handling of poisons are summarised in a final section. The book has no index.

HICKIN (N. E.). **Infestation of Foodstuffs by *Ptinus tectus* Boield. (Col., Ptinidae).**—*Ent. mon. Mag.* **78** no. 932 p. 14. London, 1942.

Adults of *Ptinus tectus*, Boield., that had been previously starved were enclosed in envelopes of transparent cellulose (a material commonly used for packets of foodstuffs) and placed on wholemeal flour in equilibrium with relative humidities of 60, 70 and 80 per cent. In all cases, they gnawed their way through to the flour. Fully fed larvae also gnawed through bolting silk and transparent cellulose films, but in this case the movement was away from the food. Pupation almost invariably takes place among débris on the outside of a mass of foodstuff. In addition, the larvae, when constructing a cocoon, will bite and tunnel through wood. Young larvae did not attempt to bite through transparent cellulose films.

HAYHURST (H.). **Insect Pests in Stored Products.**—2nd edn., Demy 8vo, xii + 108 pp., frontis., 54 pls., 21 pp. refs. London, Chapman & Hall, Ltd., 1942. Price 15*s*.

This second edition of a work already noticed [*R.A.E.*, A **28** 636] is slightly enlarged and includes an extensive bibliography.

GAY (F. J.). **A further Study of Temperature Changes during the " Turning " of Bulk Wheat.**—*J. Coun. sci. industr. Res. Aust.* **14** no. 4 pp. 245–248, 1 fig., 1 ref. Melbourne, 1941.

An account is given of further work in New South Wales [*cf. R.A.E.*, A **30** 218] in which 7,500 bushels of wheat that showed marked heating was run from one bin into another in the winter of 1941. Its average temperature was reduced from 95·5 to 79·5°F. The temperature of the air to which it was exposed during turning was 30–40°F. below that of the hottest wheat and 3·5–5·5°F. above or below that of the cooler grain. The cooling obtained under these conditions was in marked contrast to the averaging effect that took place when the grain was turned in summer [*cf. loc. cit.*].

KEY (K. H. L.). **An Analysis of the Outbreaks of the Australian Plague Locust (*Chortoicetes terminifera* Walk.) during the Seasons 1937–38 and 1938–39.**—*Bull. Coun. sci. industr. Res. Aust.* no. 146, 88 pp., multigraph, 23 figs., 24 refs. Melbourne, 1942.

The following is based on the author's summary and conclusions. The organisation of the Australian Locust Information Services is described, with special reference to New South Wales, where stock inspectors act as observers, the method by which the data are recorded on maps and analysed is explained, and an analysis of the outbreaks of *Chortoicetes terminifera*, Wlk., that occurred in 1937–38 and 1938–39 is given and discussed. The outbreak in 1937–38 was one of the most serious ever experienced in eastern Australia ; the infested area in New South Wales, where 4,250 swarms were reported, amounted to 123,000 sq. miles, while at least 28,000 sq. miles were infested in Queensland and 1,700 sq. miles in Victoria. The outbreak in 1938–39 was on a smaller scale. The area liable to be infested in a major outbreak includes very diverse climatic and physiographic regions, the limits to the spread of infestation being set by forest, mountains and climate. The dry limit is represented by a mean Meyer ratio [*cf. R.A.E.*, A **29** 141] for September–April of about 1·0, while a ratio of 12·0 represents the wet limit.

The dominant direction of flight of swarms in New South Wales is between east and south, resulting in a general south-easterly trend, but other directions dominate locally. Flight direction is correlated with the humidity gradient, 60–70 per cent. of the swarms flying towards regions of lower saturation deficit. The apparent response to the humidity gradient is probably due to a reaction to wind, the swarms distinguishing between winds differing in moisture-content,

temperature or strength, and flying with one wind and against the other; it is not due merely to the swarms being carried away by the prevailing wind. The rate of spread of the infestation is greatest at the beginning of an outbreak, when it may reach 100 miles a day, and falls off as the limits of the infestation area are approached. The rate of migration, the height at which swarms fly and the uniformity of the flight direction are connected with the number, size and density of the swarms. At times of decline in the outbreak cycle, migration is poorly developed and poorly orientated.

The life-cycle proceeds without interruption only as long as monthly mean temperature and effective rainfall (monthly Meyer ratio) remain within certain limits. If temperature is plotted against Meyer ratio, these limits can be defined by a line enclosing a zone of favourable conditions. Variation of the lower limits of temperature and moisture is slight, a mean monthly temperature of 57·5°F. [*cf.* **30** 102] and a monthly Meyer ratio of 2–3 representing the average lower limit. The upper moisture limit varies strongly with temperature, the Meyer ratio being about 10–12 at the highest temperatures investigated and 30–35 near the lower temperature limit. The eggs die rapidly at Meyer ratios higher than those that limit development at a given temperature. They can survive conditions too dry for development for about three months and too cold for development for at least five. Hoppers are quickly killed by conditions outside any of the limits for development. Adults are somewhat more resistant, but are probably unable to survive (as swarms) for more than about a month under conditions outside the favourable zone.

The dates on which the various stages of the life-cycle begin in a given locality and season depend primarily upon the date on which the weather first becomes favourable, and secondarily upon the rate of subsequent development, which in turn depends on the prevailing temperature and Meyer ratio. By adding together the effective temperatures (those above 57·5°F.) that occur at a given station during the favourable months of a given season, a "climatic index" is obtained [*cf.* **30** 102] that includes both the temperature and the moisture factor. This indicates approximately the amount of development that would occur during the season and is also a partial measure of the total favourable effect of climate and weather on the rate of multiplication, but does not show the adverse effects of unfavourable conditions, which are probably more important in regulating the population.

ROSE (A. L.). **A clinical Survey of Intoxications of Cattle by Sudan Grass** (*Sorghum sudanese*).—*Aust. vet. J.* **17** no. 6 pp. 211–219, 1 ref. Sydney, 1941.

It is stated in the course of this discussion of the conditions under which Sudan grass (*Sorghum sudanense*) is toxic to cattle grazing on it, which were studied in a district in New South Wales in which the rain falls in winter, that rain during the heat of summer induces good growth of the crop but also favours the hatching and swarming of grasshoppers. The latter attack all green vegetation and feed on Sudan grass in any stage of its growth, eating it down to the ground. If rain falls, regrowth is rapid, and the crop is then particularly dangerous to cattle. Infestation by grasshoppers has almost invariably been associated with subsequent mortality of cattle, but it is considered that their action is merely mechanical and that any other factor leading to the cutting of the crop under similar conditions would have the same result.

HUSSEIN (M.). **A Note on the Breeding and Movements of the Desert Locust, *Schistocerca gregaria* Forskal, in Egypt during 1941 (Orthoptera : Acrididae).**—*Bull. Soc. Fouad 1er Ent.* **25** pp. 203–206. Cairo, 1941.

After a minor local outbreak on the Mediterranean coast north of Kattara in the spring of 1937, Egypt was free from *Schistocerca gregaria*, Forsk., till April–May

1941, when it was reported to be breeding in considerable numbers in the desert to the east of Aswan. The population was most dense in Wadi El Khareet and part of Wadi Garrara, which receive the drainage from the neighbouring hillocks, and there the transformation into phases *congregans* and *gregaria* was observed in older hoppers, which were forced by the hot, dry summer winds to congregate in the shelter of shrubs. As the Eastern Desert of Egypt had remained rainless for six years prior to 1941, it is suggested that these hoppers were not of local origin, but were the progeny of immigrants from the Anglo-Egyptian Sudan or Arabia, where conditions favoured breeding in the autumn and winter of 1940. Control measures were completed by early June, but in the second half of that month swarms from Arabia crossed the Egyptian Red Sea coast and flew towards the Nile valley, where they turned southwards and proceeded towards the Anglo-Egyptian Sudan.

HUSSEIN (M.). **Note on the Poison-bait used in Egypt for controlling Locusts and Grasshoppers.**—*Bull. Soc. Fouad Ier Ent.* **25** pp. 211–213. Cairo, 1941.

The poison baits used against locusts and grasshoppers in Egypt are made by moistening wheat bran with a prepared solution of 2·5 lb. sodium arsenite, 4·5 litres [about 1 gal.] molasses and 2·5 litres water, the mixture being diluted with water at the rate of 1 : 15. When stored in drums, the concentrated solution tends to deteriorate, and half of the soluble arsenious oxide was found to have been converted into insoluble arsenious or arsenic oxide after storage in a 4-gallon tin for 3 years. Laboratory and field experiments with hoppers of *Schistocerca gregaria*, Forsk., in the first two instars have shown that the dosage of sodium arsenite in baits can be reduced to 0·5 lb. per 100 lb. of bran, but that the quantity of water should be not less than 15 gals. A bait made with 1 lb. sodium arsenite to 100 lb. bran gave equally good results with and without the addition of molasses. Baits containing 2 lb. sodium fluosilicate per 100 lb. bran for hoppers of the first two instars, and 4 lb. for older hoppers and adults, proved to be a satisfactory substitute for standard baits.

[D'ANGREMOND (A.).] **Verslag van den directeur van het Algemeen Proefstation der A.V.R.O.S. over het tijdvak 1 Januari 1937–31 December 1939.** [Report for 1937–39 of the Director of the General Experiment Station of the A.V.R.O.S.]—*Meded. alg. Proefst. A.V.R.O.S.*, Alg. Ser. no. 59, 76 pp. [Medan, 1940.] [Recd. 1942.]

Pests observed in the district of the Experiment Station at Medan, Sumatra, in 1937–39 included *Tiracola plagiata*, Wlk., *Coptotermes gestroi*, Wasm., *Valanga* (*Cyrtacanthacris*) *nigricornis*, Burm., and *Tarsonemus translucens*, Green, on rubber; *Setora nitens*, Wlk., and *Thosea asigna*, van Eecke, on oil palm [*Elaeis guineënsis*); *S. nitens* and *Hidari* [*irava*, Moore] on coconut; *Helopeltis* and *Phytorus dilatatus*, Jac., on tea; *Pinnaspis* (*Hemichionaspis*) *aspidistrae*, Sign., on sisal (*Agave sisalana*); *Nacoleia* (*Lamprosema*) *diemenalis*, Gn., on *Pueraria phaseoloides*; and *Xyleborus morigerus*, Bldf., on *Tephrosia vogeli*. Coffee was attacked by *Stephanoderes hampei*, Ferr., which also occurred with two other species of the genus in the bark of dead twigs of *Acacia decurrens*, which is used as a shade tree for coffee.

WOLCOTT (G. N.). **The Dispersion of *Larra americana* Saussure in Puerto Rico.**—*Rev. Agric. P. Rico* **33** no. 4 pp. 607–608, 1 map. San Juan, P.R., 1941.

The Sphegid, *Larra americana*, Sauss., was introduced into Porto Rico from Brazil in and after 1936 for the control of *Scapteriscus vicinus*, Scud. [*R.A.E.*, A **26** 223; **27** 85]. It was released in localities considered to be the most similar

to those from which it had been obtained, and has become established in three of them [*cf.* **29** 553]. Some of the failures may have been due to unfavourable weather at the time of release, since the mole-crickets are not available for parasitism in dry weather and the wasps are inactive in dull weather. In the area of greatest spread, the original releases were made during periods of daily alternation of heavy rain (which brings the mole-crickets to the surface of the ground) and bright sunshine (during which the wasps are active); drought at later periods has only temporarily halted development. The parasites were released in this area in 1939 and had spread in three directions to a maximum distance of about 5 miles by January 1941. Other failures were apparently due to the scarcity of *Borreria verticillata* and *Hyptis atrorubens*, which supply nectar to the wasps. Destruction of these weeds by cultivation shortly after a release had been made apparently eliminated one factor essential for their survival. The localities in which *L. americana* had become established by October 1941 are shown on a map, and their characteristics are discussed.

Denier (P. C. L.). **Apuntes sobre la biologia de** *Conotrachelus denieri* **Hust., plaga del algodonero.** [Notes on the Biology of *C. denieri*, a Pest of Cotton.] —*Rev. Soc. ent. argent.* **11** no. 3 pp. 185–207, 8 pls., 8 refs. Buenos Aires, 1942.

These notes are based on observations made in the Territory of Formosa, north-eastern Argentina, and in a neighbouring district in Paraguay, where *Conotrachelus denieri*, Hust., is a serious pest of cotton [*cf. R.A.E.*, A **29** 445]. The eggs are laid in cavities in the tender parts of plants of all ages and in the fruits. The larvae mine the shoots and, as soon as they become available, the bolls. Very young seedlings are almost always killed by the attack, while older plants are delayed in development but sometimes recover. Infested bolls do not open. Pupation normally occurs in the soil at a depth of about an inch. The adult weevils feed on the stems, shoots and petioles and the parts of the roots close to the collar, causing the death of very young plants. The author has not observed the weevil on any plant other than cotton, though it has been stated in Paraguay to infest wild Malvaceae occasionally, and larvae found by him on other Malvaceae have proved to be those of *C. rubicundulus*, Boh., which also infests cotton, or a still further species.

Possible methods of control are discussed. The weevil is spreading, and where it has appeared for the first time and in small fields, the most practical measure is the immediate and complete destruction of the crop and the cessation of cotton growing. The campaign of eradication that has been begun in Argentina is progressing satisfactorily, and cotton is not being grown for the present in the frontier districts.

Lizer y Trelles (C. A.). **Cochinillas halladas por primera vez en la Argentina (Hom. Sternor.).** [Coccids found for the first time in Argentina.]—*Rev. Soc. ent. argent.* **11** no. 3 pp. 230–236, 12 refs. Buenos Aires, 1942.

Records are given of 14 Coccids that occur in Argentina but were omitted from the author's previous lists [*R.A.E.*, A **27** 87; **29** 343]. They include *Ferrisiana virgata*, Ckll., on mango (*Mangifera indica*), *Pseudococcus comstocki*, Kuw., on *Citrus*, and *Trionymus sacchari*, Ckll., on sugar-cane.

de Albuquerque Leão (M.). **O expurgo pelas ondas-curtas.** [Disinfestation by Means of Short Waves.]—*Bol. Soc. brasil. Agron.* **4** no. 3 pp. 319–328, 5 figs. Rio de Janeiro, 1941.

An account is given of investigations carried out in Brazil since 1937 on the use of short waves against insect pests, mostly those infesting stored products. The periods of exposure are shorter than those required by any known fumigant.

Thus *Tenebroides mauritanicus*, L., and weevils of the genus *Calandra* (*Sitophilus*) were killed in 15 seconds. The apparatus used, which is described in some detail, is provided with a moving belt that carries the substances to be treated between the electrodes. It has a capacity of 2,000 watts and emits waves of a length of 0–6 metres. In tests to show that the effect was not due to heat, adults of *Calandra* and *Tenebroides* kept in cellophane bags in which the temperature was 50–52°C. [122–125·6°F.] appeared to be killed in 3 minutes, but recovered after 15 minutes at 28–30°C. [82·4–86°F.], whereas comparative batches in bags in which the temperature was 34–42°C. [93·2–107·6°F.] did not recover after exposure to short waves for 7 seconds. Adults of *Periplaneta americana*, L., were not affected by exposure for 3 minutes to a temperature of 60°C. [140°F.] but died after 7 seconds irradiation. Other insects tested included Lepidoptera and *Liposcelis* (*Troctes*) *divinatorius*, Müll., in cereals, Bruchids in beans, *Stephanoderes* (*Hypothenemus*) spp. and *Anastrepha fraterculus*, Wied., in coffee beans and berries, and *Lasioderma serricorne*, L., in cigars. Treated seeds were uninfested when examined up to 16 months after treatment, and the germinating power of most of them was unaffected.

Snipes (T. B.) & Vanetti (F.). **Experiências sobre o combate à formiga sauva, *Atta sexdens* (L. 1758) (Hymenoptera, Formicidae).** [Experiments in combating *A. sexdens*.]—*Rev. Ent.* **12** pt. 1–2 pp. 1–32, 1 fig., 6 refs. Rio de Janeiro, 1941.

The experiments described were carried out to assess the comparative value of nine methods that are commonly used in Brazil against the leaf-cutting ant, *Atta sexdens*, L. All of them involved the introduction of a fumigant into the nest through natural or artificial channels. The results were judged on a basis of effectiveness, cost and convenience in use. Of the five processes that gave complete control, those preferred on grounds of economy and convenience are, in the order given, burning a mixture of white arsenic and sulphur in the Werneck machine and blowing the fumes into the nest through artificial channels, pouring carbon bisulphide in through artificial channels, and pouring it in through natural ones.

Sauer (H. F. G.). **Importância, distribuição, hospedeiros e inimigos naturais do podador do algodoeiro *Chalcodermus bondari* Marshall (Col. Curc.).** [The Importance, Distribution, Food-plants and natural Enemies of *C. bondari*.]—*Rev. Ent.* **12** pt. 1–2 pp. 42–45, 8 refs. Rio de Janeiro, 1941.

The distribution, food-plants and natural enemies of *Chalcodermus bondari*, Mshl., which is not a major pest of cotton, though it does a certain amount of damage in north-eastern Brazil and in parts of the Chaco region in Argentina, are reviewed from the literature [*cf. R.A.E.*, A **27** 413, etc.]. In São Paulo, the larvae are parasitised by a Braconid of the genus *Heterospilus* and a Pteromalid near to *Zatropis incertus*, Ashm.

Stahel (G.) & Geijskes (D. C.). **Weitere Untersuchungen über Nestbau und Gartenpilz von *Atta cephalotes* L. und *Atta sexdens* L. (Hym. Formicidae).** [Further Investigations on the Structure of the Nests and on the cultivated Fungus of *A. cephalotes* and *A. sexdens*.]—*Rev. Ent.* **12** pt. 1–2 pp. 243–268, 5 pls., 9 figs., 10 refs. Rio de Janeiro, 1941.

The authors record the results of further excavations of the nests of *Atta cephalotes*, L., and *A. sexdens*, L., in Dutch Guiana [*cf. R.A.E.*, A **27** 567], an old and a new nest of each ant being examined. They describe a modification of the method of making plans of vertical sections of a nest that renders it applicable to uneven ground. The identity and forms of the fungi found in the nests are discussed, and the results of laboratory cultures are given.

Bondar (G.). **Notas entomológicas da Baía. VII, VIII.**—*Rev. Ent.* **12** pt. 1–2 pp. 268–303, 18 figs. Rio de Janeiro, 1941. *T.c.* pt. 3 pp. 427–470, 31 figs., 35 refs. 1942.

The first of these two parts of a series on insect pests in Bahia [*cf. R.A.E.*, A **29** 468] comprises descriptions of new Coleoptera, chiefly weevils on palms other than coconut and oil palm (*Elaeis guineënsis*), and a further note on *Himatidium neivai*, Bond., which is a pest of coconut [*cf. loc. cit.*]. The original food-plants of this Hispid are native palms, and it is particularly common on *Desmoncus polyanthoacanthos* and *Bactris* sp. *H. neivai* also attacks the young fruits of *E. guineënsis*, preventing normal development, and is considered to have been mainly responsible for the failure of many plantations. It could possibly be controlled by the destruction of native palms near plantings and by spraying against the larvae and adults, both of which feed externally on the fruits. Other pests of *E. guineënsis* in Bahia are the weevils, *Rhina barbirostris*, F., and *Rhyncophorus palmarum*, L., which infest injured trunks, the Buprestid, *Taphrocerus cocois*, Bond., which feeds on the leaflets, and the weevil, *Parisoschoenus obesulus*, Csy., which feeds in the pulp of the fruits.

The second part contains a discussion of the systematic position of some of the genera of Brazilian weevils, and notes on the habits and food-plants of a considerable number of them that were not included in da Costa Lima's Catalogue [**24** 607] but which have been taken by the author in Bahia, with descriptions of 21 new species, most of which were bred from native palms. The others include *Chalcodermus yvensi*, sp. n., which infests beans in the State of Espírito Santo. The female deposits 1–3 eggs in an immature pod and then severs the portion containing them so that it drops off. The larvae leave the pod after about a week and pupate in the ground, complete development lasting 20–23 days. Beans in the States of Rio de Janeiro and Espírito Santo are also attacked by *C. angulicollis*, Fhs. The destruction of the fallen pods is the only measure of control available. *C. canavaliae*, sp. n., is described from *Canavalia obtusifolia* in Bahia.

The palm weevils include *Derelomus elaeisae*, sp. n., which feeds on the pollen in the male flowers of *Elaeis guineënsis*. The preparation of a powdered wax from *Cocos coronata* is becoming of commercial importance in Bahia, but the stored wax is subject to infestation by *Lasioderma serricorne*, L. It should not be stored for longer than two months if infestation is to be avoided.

Townsend (C. H. T.). **New Fly Parasites of *Diatraea* in São Paulo.**—*Rev. Ent.* **12** pt. 1–2 pp. 339–341. Rio de Janeiro, 1941.

Descriptions are given of the adults of both sexes of the Tachinids, *Parthenoleskia parkeri*, gen. et sp. n., and *Zenillia* (*Palpozenillia*) *diatraeae*, sp. n., which were bred in 1941 from *Diatraea saccharalis*, F., in maize in São Paulo. *Nepophasmophaga facialis*, Tns., was reared in numbers from *D. saccharalis*, and the author states that dissection of the females indicates that it deposits eggs on tender maize shoots, which are eaten by young *Diatraea* larvae before they enter the stalks.

Fenton (F. A.). **Protecting stored Wheat against Insects.**—*Circ. Okla. agric. Exp. Sta.* no. 95, 8 pp., 4 figs. Stillwater, Okla., 1941.

Owing to the lack of sufficient terminal storage space and possible shortage of transport, large amounts of wheat will have to be stored in bins on farms in Oklahoma and will be subject to serious infestation by insects. Notes are therefore given on the sources of infestation, the life-histories of the Angoumois grain moth [*Sitotroga cerealella*, Ol.] and the rice weevil [*Calandra oryzae*, L.],

which are common and injurious in the State, and methods of prevention and control. These include prompt harvesting, scrupulous cleanliness, spraying the empty bins with a strong contact spray, and fumigation.

The fumigants recommended are carbon bisulphide or a mixture of ethylene dichloride and carbon tetrachloride (3 : 1) [*cf. R.A.E.*, A **27** 341] applied by pouring from a container or watering-can or by a small spray pump to grain that is then covered with a tarpaulin. It is stated in an addendum, however, that carbon bisulphide should not be applied by the former method during hot weather, since recent experience has shown that it then evaporates so quickly as to be dangerous to the operator. It should be applied from a pump or through a series of funnels inserted into the grain.

Cook (C. W.). **Insects and Weather as they influence Growth of Cactus on the Central Great Plains.**—*Ecology* **23** no. 2 pp. 209–214, 6 figs., 4 refs. Brooklyn, N.Y., 1942.

The investigations described were begun in 1937 in Kansas, where they were largely confined to *Opuntia humifusa*, and were later extended to Texas, Oklahoma, Nebraska and Colorado. Their object was to determine the causes of the increase of cacti during periods of drought and their decrease during moderately wet ones, and it was found that insects played a large part in the control of these weeds. Those found feeding on cactus were the Pyralid, *Melitara dentata*, Grote, *Dactylopius* sp. and the Coreid, *Chelinidea vittiger*, Uhl.

The eggs of *M. dentata*, which is the most important, hatch in March–June, and the young larvae feed in the fleshy stems until August–September, when they emerge from the plant and pupate in cocoons. The adults emerge in 2–3 weeks and lay eggs in sticks of 60–100 attached to the spines of the plants or other protected objects. These eggs usually fall into the undergrowth before spring, where they remain until conditions are suitable for hatching. Under conditions similar to those during periods of moderate rainfall, 85 per cent. of the larvae gave rise to adults, the latter lived for an average of 20 days and the average number of eggs deposited per moth was 585, whereas the corresponding figures under drought conditions were only 30, 6 and 6, respectively. It is believed that this Pyralid keeps the cactus in check during periods of normal rainfall. *Dactylopius* sp., the second in importance, thrives best in moist, warm conditions and kills many cactus plants during periods favourable to it. *C. vittiger*, which is apparently little influenced by weather, has two generations a year, the adults emerging in summer and late autumn. Some of the adults overwinter under rubbish at the base of the plants. The eggs are laid along the spines of the plants and hatch in early spring.

The author concludes that drought is the primary factor controlling the balance between cactus and insects, but that proper grazing of the native forage helps considerably in producing a favourable habitat for the insects, thus inducing an increase in their numbers and a decrease in cactus.

Denning (J. A.). **Field Notes on the Life History of *Parlatoria chinensis* Marlatt.**—*Proc. Mo. Acad. Sci.* **7** no. 4 p. 103. Columbia, Mo. 1942.

Parlatoria chinensis, Marl., which had not previously been recorded from the United States, was found in Missouri in 1940 on plants of about 35 genera, including *Pyrus*, *Prunus* and *Hibiscus*. Eggs were seen during the latter half of June, and crawlers from 5th July until 27th September, their peak of activity occurring about 19th August.

Hixson (E.). **The Walnut Datana.**—*Bull. Okla. agric. Exp. Sta.* no. 246, 29 pp., 8 figs., 6 refs. Stillwater, Okla., 1941.

The first recorded outbreak of *Datana integerrima*, G. & R., in Oklahoma occurred in 1935–37, when it caused serious damage to black walnut (*Juglans nigra*) and pecan trees throughout the State and was also present on hickory. It usually has two generations a year in Oklahoma, and the outbreak began with the second-generation larvae, which seriously defoliated the trees during September and October 1935. By July 1936, first-generation larvae had defoliated large numbers of trees, but no moths emerged and no further damage occurred that year; apparently the hibernation of first-generation pupae from one year to the next is not unusual. Both generations developed in 1937, and damage was widespread, many trees being defoliated twice during the year. In 1938, adults of the overwintered generation were abundant and eggs were deposited in large numbers, but many of the eggs were parasitised and most of the larvae that hatched were destroyed by predators. No further damage occurred until 1940, when the second-generation larvae were sufficiently abundant to defoliate small trees and occasional large ones. Defoliation weakens the trees and decreases the quality of the nut crops.

An account is given of the results of studies on the life-history and control of this Notodontid at Stillwater during 1937 and 1938, and all stages are described. Its bionomics are similar to those recorded from Missouri [*cf. R.A.E.*, A **29** 166], and the egg, larval, prepupal and pupal stages averaged 6–7, 19, 2 and 33·3 days, respectively. The average number of eggs in a cluster was 800, and the average height above the ground at which the eggs were laid was 7·8 ft. The eggs are parasitised by *Trichogramma minutum*, Riley, and *Telenomus ichthyurae*, Ashm., which caused the great reduction of the population in 1938, and the larvae by *Anomalon* (*Labrorychus*) *relictum*, F., which was not abundant, and the Tachinids, *Achaetoneura frenchi*, Will., and *Phorocera claripennis*, Macq., which were common but ineffective owing to superparasitism. The most important of the predators observed was *Polistes canadensis* var. *annularis*, L., which destroyed many larvae in the spring of 1938.

The control measures tested comprised those used in Missouri [**29** 167] and dusting with calcium arsenate from the ground or from an aeroplane. It is concluded that the best method to use depends on such factors as the type of grove and cost of labour, but that the lead-arsenate spray is the most effective and is improved by the addition of fish oil (0·5 pint per 100 gals.) as an adhesive. Dusting with calcium arsenate is not recommended except in case of emergency, when a large number of trees can be quickly covered by aeroplane.

Rainwater (C. F.) & Bondy (F. F.). **Boll Weevil and Cotton Aphid Control by the Use of Derris in Combination with Calcium Arsenate.**—*J. econ. Ent.* **34** no. 6 pp. 733–735, 6 refs. Menasha, Wis., 1941.

Tests on the effect on *Aphis gossypii*, Glov., of adding derris to dusts of calcium arsenate or equal quantities of calcium arsenate and sulphur, applied to cotton for the control of *Anthonomus grandis*, Boh. [*cf. R.A.E.*, A **28** 649], were continued in Mississippi [*cf.* **30** 263], South Carolina, Louisiana and Texas in 1940. Enough derris was used to give the mixed dusts a rotenone content of 0·5 per cent. Eight effective applications at the rate of 12 and 6 lb. per acre of dusts with and without sulphur, respectively, were made in each locality at 5-day intervals, beginning when the first blooms appeared, but the data on *Anthonomus* in South Carolina and on the Aphid in Texas were not analysed, as the infestations were too light. Statistical analysis of the remaining results showed no significant differences between any two treatments in the control of *Anthonomus*, but a highly significant difference between each treatment and the

untreated plots. Aphid populations were significantly lower after treatment with the dusts containing derris than after those without it, and in some localities, yields were significantly higher after treatment with calcium arsenate and derris than after calcium arsenate alone ; in some instances the addition of sulphur to the dusts caused significant reductions in the numbers of Aphids. These results were confirmed by the experience of a group of farmers in North Carolina who used a mixture of equal parts of calcium arsenate and sulphur containing enough cubé to give a rotenone content of 0·5 per cent., and it is concluded that injurious numbers of Aphids will not occur as a result of dusting cotton with calcium arsenate for the control of *A. grandis* if the dust contains this amount of rotenone.

Bibby (F. F.) & Moreno (I.). **Secondary Hosts of the Pink Bollworm in the lower Rio Grande Valley of Texas and Mexico.**—*J. econ. Ent.* **34** no. 6 pp. 736–737, 2 refs. Menasha, Wis., 1941.

Platyedra (*Pectinophora*) *gossypiella*, Saund., which is a pest of cotton, was bred from *Hibiscus esculentus* and, in small numbers, from *Malvaviscus drummondi* in the lower Rio Grande Valley in Texas and Mexico in 1939-40 [*cf. R.A.E.*, A **29** 430]. *Pseudabutilon lozani* was found to be a third alternative food-plant, two adults emerging in November and December from mixtures of flower buds and seed pods collected in Texas in November 1940.

Glick (P. A.) & Ewing (K. P.). **Studies of Insect Damage to Cotton with Reference to Soil-conservation Practices.**—*J. econ. Ent.* **34** no. 6 pp. 737–741, 3 refs. Menasha, Wis., 1941.

An account is given of studies that are being made to determine the effect of the latest farming and soil-conservation practices in the Blacklands of Texas on insects injurious to cotton. The plan of operation, the records made, the scope of the insect studies and the methods of making population counts of the different insects are described. Detailed seasonal infestation records are being made of cutworms, the cotton Aphid [*Aphis gossypii*, Glov.], thrips, the cotton flea hopper [*Psallus seriatus*, Reut.], the boll weevil [*Anthonomus grandis*, Boh.], the bollworm [*Heliothis armigera*, Hb.], the cotton leaf worm [*Alabama argillacea*, Hb.], the fall armyworm [*Laphygma frugiperda*, S. & A.] and Pentatomids, and records are made of any unusual outbreaks of other insects on cotton ; infestation records of *H. armigera* on maize are also being made, so that the abundance and seasonal activity of this species on its different food-plants may be traced. The survey has been in operation for only two years, and no trends are so far evident ; it is anticipated that the work will not be completed for at least nine or ten years.

De Bach (P.) & Smith (H. S.). **The Effect of Host Density on the Rate of Reproduction of entomophagous Parasites.**—*J. econ. Ent.* **34** no. 6 pp. 741–745, 1 fig., 10 refs. Menasha, Wis., 1941.

The authors point out that if parasites of insects are to regulate the population densities of their hosts, they must be able to destroy a greater fraction of the population when it is dense than when it is sparse, and describe an experiment designed to investigate the effect of host density on the rate of reproduction of two parasites through its relation to their success in finding hosts. The experiment was restricted to single generations and a constant parasite density. When sets of 40 adults of *Mormoniella vitripennis*, Wlk., were kept for 24 hours at a temperature of 80°F. in tins of a capacity of 10 U.S. gals. containing 1, 5, 25, 50, 100, 200 or 300 pupae of *Musca domestica*, L., distributed at random in 2 U.S. quarts of barley and covered with an additional U.S. quart to hide any puparia near the surface, they attacked averages of

0·89, 4, 17·57, 31·5, 48·25, 54·25 and 62 hosts, respectively, and when the same experiment was repeated with sets of 40 adults of *Muscidifurax raptor*, Gir. & Sand., they attacked all the pupae in tins containing 100 or less and averages of 189·33 and 239 in tins containing 200 and 300, respectively. It is evident that the number of hosts found by *Mormoniella* increased with increasing host density for a time and then approached a fixed number asymptotically, the reduction in the rate at which discovery increased with host density apparently being caused by the increasingly greater proportion of time spent in non-searching activities, chiefly oviposition, feeding and resting, as the host density increased.

The authors consider that the experiment illustrates the importance of searching capacity, as opposed to potential reproductive capacity, in the determination of the efficiency of a parasite.

Boyce (A. M.) & Korsmeier (R. B.). **The Citrus Bud Mite, *Eriophyes sheldoni* Ewing.**—*J. econ. Ent.* **34** no. 6 pp. 745–756, 9 figs., 4 refs. Menasha, Wis., 1941.

Descriptions are given of all stages of *Eriophyes sheldoni*, Ewing, and also of the injury that it causes to lemons by feeding on the buds [*cf. R.A.E.*, A **27** 55] or under the buttons of the fruit, where it blackens the rind tissue. It was first observed in 1937, when it became evident that it was responsible for a characteristic type of injury to lemons in Ventura County, California [*cf.* **26** 173], and it has been numerous in most lemon-growing areas in Santa Barbara County since 1939. It occurs on all species and varieties of *Citrus* grown in these Counties, including limes, and also in three other Counties in southern California, and mites that are considered by H. H. Keifer to be variations of it have been observed in Queensland, on most varieties of *Citrus* in New South Wales [*cf.* **28** 288] and on mandarin oranges on Oahu, Hawaii. It is disseminated locally by wind and is probably spread to uninfested areas on nursery stock ; lemon is the only fruit that is seriously affected in California, and most of the plantations in which infestation is severe are in the coastal and intermediate areas. The degree of infestation on Valencia oranges has increased during the past two years. Seed-bed budding stock of all varieties, budded nursery trees and newly planted young lemon and orange trees are often seriously injured, but characteristic damage is seldom severe on growth more than two years old.

The eggs are deposited singly or in small groups in protected places ; they are most numerous within the buds, where up to 50 mites and eggs are commonly found, or on the tender growth of expanding buds and beneath the buttons of fruits. Development from egg to adult lasted 7 days at 75°F. in the laboratory and 10 and 15 days during summer and autumn, respectively, in the field. The ratio of males to females was 1 : 2·3 in August and 1 : 20 in December in the buds, and approximately 1 : 2·5 throughout the year under the buttons of the fruits. In certain localised areas, temperatures above 110°F. apparently caused up to 50 per cent. mortality of the mites, and a temperature of 118°F. in Australia is stated in a letter by P. C. Hely to have caused complete mortality of all stages, though one of 112°F. had no adverse effects.

Studies on control were carried out on a large scale in 1938–41, the results of the treatments being estimated by counts before treatment and at intervals after it ; the method of field sampling developed is described. Fumigation of tented trees with hydrocyanic acid gas or vaporised nicotine was not consistently effective. The petroleum-oil spray regularly used on *Citrus* and sprays of sulphur or materials containing it were the most effective of those tested. Light-medium or medium grade petroleum oil at the usual concentration of 1·67 per cent. gave the most generally satisfactory control of *E. sheldoni* as well as of *Paratetranychus citri*, McG., and *Saissetia oleae*, Bern. A weak oil

spray (0·75 per cent. light-medium oil) in combination with powdered rotenone-bearing roots is less effective against the mites, but is often used, particularly during late winter and spring when a large percentage of the crop of lemons is maturing, as it is less injurious to the fruit than the full dosage of oil. Ammonium polysulphide, lime-sulphur, wettable sulphur and an inverted emulsion of oil and sulphur give effective control of *E. sheldoni* but not of the other pests, and may damage fruit and foliage at high temperatures. In preliminary tests with aqueous solutions of various organic compounds, the triethanolamine salt of 2–4-dinitro-6-cyclohexylphenol, used at a concentration of 0·025 per cent. of the parent phenol with a proprietary wetting agent, showed most promise for the control of both mites. At present it appears that two treatments per year with any of the materials now available may be required in many of the infested areas.

The predators, *Leptothrips mali*, Fitch, *Arthrocnodax* sp., *Seiulus* sp. and *Cheletomimus ornatus*, Berl., which are commonly found associated with *E. sheldoni*, do not appear to be of importance in reducing its numbers.

Hills (O. A.). **Isolation-cage Studies of certain Hemipterous and Homopterous Insects on Sugar Beets grown for Seed.**—*J. econ. Ent.* **34** no. 6 pp. 756–760, 2 figs. Menasha, Wis., 1941.

Sugarbeet has been grown for seed commercially in the United States since 1935, but in certain years the viability of the seed produced has been unsatisfactory. Investigations were therefore carried out in the Salt River valley of Arizona to determine which insects occurred in the beet fields and their effect on seed production. Surveys in 1938 indicated that, apart from *Eutettix tenellus*, Baker, which, by transmitting curly-top disease, tends to reduce the yield rather than the viability of the seed, *Lygus* spp., several species of Pentatomids and *Nysius ericae*, Schill., were likely to be of the greatest economic importance. The results are given of investigations to determine the type of damage attributable to mixed populations of *L. hesperus*, Knight, and *L. oblineatus*, Say, as they occurred in the field in 1938 and to the same species of *Lygus*, *Chlorochroa sayi*, Stål, *Thyanta custator*, F., *N. ericae* and *Myzus persicae*, Sulz., in 1939. Cages designed to enclose the entire inflorescence of a single plant were placed in the field, and insects were introduced into some of them. The seed was harvested and analysed to determine the quantity and quality of that produced in each cage, and the damage caused by the various species of insects was determined. It was found that *Lygus*, *C. sayi* and *T. custator* caused significant reductions in the percentage of viable seed produced per plant; the number of seed balls was not reduced, but the seed was slightly lighter in weight. Up to 500 adults of *N. ericae* per plant had no measurable effect on the quantity or quality of the seed produced, and heavy infestations of *M. persicae* drastically reduced the quantity of seed but did not significantly reduce its viability.

Bartlett (B. R.) & Persing (C. O.). **Laboratory Control Studies on the Greenhouse Thrips.**—*J. econ. Ent.* **34** no. 6 pp. 760–766, 4 refs. Menasha, Wis., 1941.

Owing to the increasing importance of *Heliothrips haemorrhoidalis*, Bch., which scars the fruits of Valencia oranges in localised areas in California [*cf. R.A.E.*, A **26** 508], laboratory investigations on its control by means of contact insecticides, stomach poisons and ovicides were made in 1939. The adults were readily killed by sprays containing pyrethrum, nicotine sulphate, derris extract with 2 (4-tertiary-butyl-phenoxy) ethanol as a solubiliser, or the dicyclohexylamine salt of 2,4-dinitro-6-cyclohexylphenol, all in petroleum oil, or the nicotine or triethanolamine salt of this phenol or pyrethrum alone,

and by dusts containing 2,4-dinitro-6-cyclohexylphenol, its dicyclohexylamine salt, or pyrethrum, all at concentrations likely to be practicable for use on *Citrus* in the field. Of stomach poisons used with sucrose, tartar emetic killed 70·5 per cent., related antimony compounds were less effective, and cryolite and barium fluosilicate gave mortalities of only 9·5 and 3·7 per cent. Tartar emetic was not effective in later field tests.

A highly refined light-medium petroleum oil killed about 40 per cent. of the eggs at a concentration of 1·67 per cent. and caused some mortality at 0·5 per cent. ; the results obtained with Diesel oil and ground-nut oil at 0·5 per cent. probably did not differ significantly from those with petroleum oil at the same concentration. Kerosene at 8 per cent. had little effect. When applied in sprays of 0·5 per cent. petroleum oil, pyrethrum extract (2·57 per cent. pyrethrins) at 0·25 pint per 100 gals. gave approximately the same percentage mortalities of 5 and 10-day-old eggs (99·9 and 96·9 per cent., respectively) as nicotine sulphate at 2 pints (84·2 and 97·9 per cent.). Of the other materials tested with oil on 10-day-old eggs, 2,4-dinitro-6-cyclohexylphenol was very effective and its dicyclohexylamine salt gave complete mortality ; the nicotine salt of this compound was less satisfactory. Sulphur was effective with 0·5 per cent. petroleum oil, but not without it, and sprays containing rotenone were relatively useless.

Kido (G. S.). **Methyl Bromide Fumigation of Strawberry Planting Stock to control** *Paria canella* **var.** *quadrinotata* **(Say).**—*J. econ. Ent.* **34** no. 6 pp. 766–768, 2 refs. Menasha, Wis., 1941.

Paria canella var. *quadrinotata*, Say, which is a major pest of strawberry in the central coast and Sacramento districts of California, has recently become established in an area in which an extensive breeding programme for the development of new strawberry varieties is being carried out, and methods of destroying the adults of this Eumolpid were therefore investigated, in order to minimise the danger of transferring them. The adults are the only stage concerned during fumigation in early spring, but the risk of spread is increased by the fact that they are parthenogenetic, all those dissected being females. In December 1939, potted non-dormant plants of *Fragaria chiloensis* and three commercial varieties of strawberry together with 50 adults of *Paria* in fine-mesh brass screen tubes were fumigated at atmospheric pressure with 1, 2, 3, 4 or 5 lb. methyl bromide per 1,000 cu. ft. for 2 hours at 79–88°F. The 1 and 2 lb. dosages resulted in 22·5 and 100 per cent. mortality of the beetles, respectively, and plants treated at the three lower dosages grew normally, but the others developed numerous dwarfed and twisted petioles. In March 1940, dormant plants of two varieties, with 50 *Paria* adults in tubes, were fumigated at reduced pressure with dosages of 2 and 3 lb. methyl bromide per 1,000 cu. ft. for 1, 2 and 3 hours at a temperature of 72–74°F. The vacuum (27 ins. at the beginning of fumigation) was gradually reduced until atmospheric pressure was reached. Complete mortality of the beetles was obtained with dosages of 2 lb. for 3 hours or 3 lb. for 2 hours, and the development of runners and, in one variety, the weight of the plant increased during the growing season as the dosage at which the plants had been fumigated increased.

Hastings (E.) & Pepper (J. H.). **The Distribution of Sodium Arsenite and Diluent in the Dust Cloud.**—*J. econ. Ent.* **34** no. 6 pp. 769–772, 1 graph. Menasha, Wis., 1941.

In view of the possibility that the erratic results sometimes obtained in the Rocky Mountain States in the control of the Mormon cricket [*Anabrus simplex*, Hald.] with dusts of sodium arsenite and diatomaceous earth (1 : 3) or hydrated lime (1 : 4) might be due to chemical or physical reactions between the poison

and the diluent, the constitution of a number of mixed dusts was investigated after they had been discharged through a nozzle. Preliminary tests showed that when mixtures of sodium arsenite and volcanic ash (1 : 3) of various relative sizes, in which the coarse particles were invariably coated with the fine ones, were discharged from a nozzle, the agglomerates broke up. In further tests, mixed and unmixed dusts were discharged into a tunnel 40 ft. long, 5 ft. high and 4 ft. wide, and samples of dust taken at intervals of 1 ft. for a distance of 18 ft. from the nozzle were analysed. With all the unmixed dusts it was found that settling was directly proportional to particle size. The figures given for mixtures refer to dusts containing 25 per cent. sodium arsenite. From a mixture of coarse sodium arsenite (average particle size 13 microns) and diatomaceous earth (1·2 microns) samples collected 3, 5, 8 and 13 ft. from the nozzle contained approximately 75, 69, 25 and 11 per cent. sodium arsenite, respectively ; from a mixture of medium sodium arsenite (4 microns) and the same diatomaceous earth, the greater part of the sodium arsenite again settled out within the first eight feet, but there was a larger proportion in the cloud beyond this point than in the first case ; and from a mixture of fine sodium arsenite (2 microns) and celite (less than 1 micron) the two materials settled out relatively uniformly throughout the distance investigated. The densities of the sodium arsenite, diatomaceous earth and celite were 3·44, 1·96 and 1·99 gm. per cc., respectively. Comparison of the proportions of the dusts deposited within given distances showed a marked similarity between the percentages of sodium arsenite or celite from mixed and unmixed materials. It is concluded that no interaction took place between the diluents and the active ingredient, and that the composition of a dust cloud obtained from the use of the dusts tested is dependent on particle size. However, if the densities of the materials or the particle shape in a dust mixture varied considerably, these would have to be considered.

KIRKPATRICK (A. F.). **The Control of Black Scale in Olive Orchards by Calcium Cyanide Dusting.**—*J. econ. Ent.* **34** no. 6 pp. 772–777, 5 figs. Menasha, Wis., 1941.

In recent years, *Saissetia oleae*, Bern., has caused serious damage to commercial plantings of olive in the San Joaquin and Sacramento Valleys of California, probably owing to the absence of summers with prolonged periods of excessively high temperatures and to changes in cultural practices, including heavier and more frequent irrigation, orchard fertilisation, resulting in increased foliage vigour and density, and decreased pruning. The Coccid has only one generation a year ; hatching occurs chiefly in the second half of May and throughout June, and the young remain relatively small during the summer and autumn. In experiments, tent fumigation with Cyanogas calcium cyanide at the normal dosage for *Citrus* trees and at half this rate on a warm calm night in August 1939 resulted in complete mortality on the treated trees and considerable mortality, due to escaped gas, on adjacent ones, and similar treatment of large heavily infested trees in late November at dosages ranging from the normal *Citrus* dosage to one-eighth of this for 45 minutes resulted in almost complete mortality, with no significant differences between dosages. The surviving scales were in the more advanced stages of development.

In 1940, attempts were made to fumigate large infested trees without using tents by enveloping them in moderate concentrations of hydrocyanic acid gas from calcium cyanide (Cyanogas A-Dust) distributed rapidly through a block of trees during a period of calm atmospheric conditions, such as occur in this area during summer nights following relatively high day temperatures. On 11th June, the dust was applied in an orchard in which approximately 70 per cent. of the eggs had hatched, at the rate of 40 lb. per acre from a truck driven through alternate spaces between tree rows at about 5 miles per hour ; a

month later, 98·1 per cent. of the scales in the lower portion of the trees and 93 per cent. in the upper portion were dead, as compared with 30 per cent. on untreated trees, many of the living scales probably having hatched after treatment. The treatment was applied to other orchards on 26th June and 20th July and gave similar results, and in consequence, 200 acres were dusted commercially between 6th July and 7th September; inspection during the early summer of 1941 showed that whereas the scale population had generally increased to 10–20 times its initial size on untreated trees, it was no greater, and generally less than it had been, over 90 per cent. of the treated area. There was no difference in effectiveness between treatments given at different times and no injury to the trees. It is considered that 40 lb. per acre is the minimum effective dosage, and that 50–60 lb. may give the most economical control.

The author states that, to obtain the best results, large areas should be dusted in a minimum time, the duster being driven through every second or third space between tree rows, that work should be started at the side of the orchard towards which the dust will probably drift and that the dust should be directed upward and outward into the trees. All operators should wear gas masks. In all the treatments observed in 1940, injurious concentrations of HCN were dissipated within 45–50 minutes of application.

FULTON (R. A.), BUSBEY (R. L.). & YUST (H. R.). **The Behavior of Hydrocyanic Acid Gas under a Fumigation Tent.**—*J. econ. Ent.* **34** no. 6 pp. 777–783, 5 figs., 1 ref. Menasha, Wis., 1941.

It was observed during field studies in California over a number of years that there was a wide variation in the concentration of hydrocyanic acid gas in tents over adjacent *Citrus* trees fumigated against *Aonidiella aurantii*, Mask., although the gas was released with the same apparatus, and that the concentrations also varied at different points under the same tree. Studies with HCN in a gastight box showed that, even in the absence of foliage, the time required for the gas to reach a uniform concentration was much longer than it has generally been assumed to be, and further studies of the distribution of this gas in fumigation tents were made. An orange tree, covered with a tent on a framework 14 ft. high and 16 ft. in diameter at the bottom, was fumigated with a dosage equivalent to 18 cc. HCN per 100 cu. ft. by the pot method and by the use of vaporised or atomised liquid HCN, and 1 litre samples from 6–14 points in the tent were drawn through a solution of 2 per cent. sodium hydroxide and analysed by titration. With all three methods it was found that about five minutes was required for the distribution of the gas within the tent, that the concentration near the periphery of the tent was never so great as that in the interior and that spots of high concentration occurred at the top of the tent and on the side opposite the point of liberation of the gas. Analysis showed that when the liquid was atomised, a large proportion of the acid remains as a liquid on the ground or is absorbed by the soil. When the gas was diluted by means of vane or propeller types of fans with capacities of 2,000 and 300 cu. ft. air per minute, respectively, placed under the tent and run for 30 seconds after the gas was released in the air stream, it was detected in all situations immediately and the concentration was the same in the peripheral region as in the interior. No difference was detected in the distribution obtained with the two types of fans. Satisfactory distribution of the gas was also obtained with the fan in lemon trees covered with regular fumigation tents. When lemons infested with a resistant strain of *A. aurantii* were placed under the tent and fumigation was carried out at a dosage of 14 cc. per 100 cu. ft., there were significant differences in mortality at different points without a fan, but practically none with one.

McKenzie (H. L.). *Matsucoccus bisetosus* **Morrison, a potential Enemy of California Pines.**—*J. econ. Ent.* **34** no. 6 pp. 783–785, 3 figs. Menasha, Wis., 1941.

This preliminary paper contains information accumulated during 1940 and 1941 on *Matsucoccus bisetosus*, Morrison, which is apparently the most important of the Coccids of this genus that seem to be injurious to pines in California [*cf. R.A.E.*, A **30** 1]. It attacks the twigs, branches and trunks of pines (*Pinus ponderosa* and *P. jeffreyi*) of all ages, apparently causing the bark to become cracked and rough; on mature trees its attack on the trunk is limited principally to the upper crown. The immature Coccids are commonly found in the crotches of small branches, where they cause resin to collect on the bark surface and often in the cortex tissue, which apparently retards the normal physiological functions of the branch and causes shortening and thinning of the needles. Extensive feeding on the twigs and in the crotches is thought to kill the branch ultimately, the needles fading, turning a deep sorrel colour and then falling. Infestations seem to be rather general throughout the pine stands of California and Oregon; outstanding records of the occurrence and effects of the scale are shown in a table. Preliminary observations indicate that this species may be one of the important factors in the decadence of mature forests of *P. ponderosa* and *P. jeffreyi* that supply the lumbering industry in California.

Mallis (A.). **Preliminary Experiments on the Silverfish** *Ctenolepisma urbani* [*sic*] **Slabaugh.**—*J. econ. Ent.* **34** no. 6 pp. 787–791, 9 refs. Menasha, Wis., 1941.

Ctenolepisma urbana, Slabaugh, which was described in 1940 (*Ent. News* **51** pp. 95–98), is an important household pest in southern California, where it causes some injury when infestation is severe. It attacks paper, including wallpaper and prints, textiles, particularly those that are starched, and the binding of books, but usually causes severe damage only to articles that have been undisturbed for some time. Modern buildings are often severely infested; an even temperature throughout the year is favourable to its multiplication, and it spreads throughout the building from the basement, where infestation is usually most severe, by means of ventilators and heat conduits. Of various commercial types of paper, it fed readily on highly refined chemical pulp papers; papers with a high mechanical pulp content were not fed on [*cf. R.A.E.*, A **29** 56] unless exposed for a long time. In tests with six undyed textiles and under natural conditions, it fed on the vegetable fibres, linen being preferred to rayon, cotton and lisle, but avoided the animal fibres (silk and wool) almost completely.

Cards dipped in a paste containing 7 per cent. by weight of white arsenic in flour are commonly used for the control of silverfish, but when poison cards and cards coated with flour paste only were exposed in a place heavily infested with *C. urbana*, the flour paste was almost completely removed from the unpoisoned cards at the end of two weeks, but there was no evidence of feeding on the poisoned paste at the end of six weeks. An experiment with cards coated with twelve pastes commonly used for the control of silverfish showed that flour, with or without sugar or salt, and beef extract, are extremely attractive to this species. When slips of paper coated with pastes consisting of insecticide, flour and distilled water (7 : 93 : 200) were put out, those containing tartar emetic and sodium arsenite were not touched under natural conditions, sodium fluoride, sodium fluosilicate and white arsenic were repellent and barium fluosilicate and barium carbonate were not. Silverfish confined in jars containing sodium-fluoride or sodium-fluosilicate dust died in averages of 5 and 6·8 days, respectively; those confined with pyrethrum containing 0·75 per cent. pyrethrins became paralysed in 3–10 minutes and died in 1–11 days. The time of paralysis was not affected by the addition of sodium fluoride or sodium

fluosilicate to the pyrethrum (4 : 1), but mortality occurred in 1–3 days. Traps consisting of 1 oz. glass jars bound round the outside with tape to enable the silverfish to walk up them and containing a teaspoonful of white wheat flour caught an average of 13·6 silverfish in 120 days in the basement of a heavily infested building.

Hoskins (W. M.). **Some recent Advances in the Chemistry and Physics of Spray Oils and Emulsions.**—*J. econ. Ent.* **34** no. 6 pp. 791–798, 2 figs., 27 refs. Menasha, Wis., 1941.

In this first paper of a symposium on oil sprays, the action of emulsifiers, wetting agents and solubilisers and the penetration and oxidation of spray oils are discussed, mainly from the literature. The following is substantially the author's summary. The number of synthetic wetting and emulsifying agents available is increasing, but most of them are of doubtful value in oil sprays because they reduce deposit. Under the influence of solubilising agents, oil becomes soluble to a marked extent in aqueous solutions and the same phenomenon occurs with normally insoluble substances in oil as a solvent in the presence of the proper solubiliser. The spreading of oil on water is promoted and penetration into foliage is retarded by small concentrations of semipolar compounds. On the other hand, inert hydrocarbons, such as oils, seem to assist semipolar toxic compounds, for instance alcohols, in penetrating insect integument. Oxidation of unsaturated hydrocarbons to form complex acids is chiefly responsible for leaf injury. The unsulphonatable residue test is not always a satisfactory criterion for estimating the tendency to oxidise, but a practical substitute test has not yet been found.

Cressman (A. W.). **Methods of measuring Spray Oil Deposits.**—*J. econ. Ent.* **34** no. 6 pp. 798–804, 2 figs., 18 refs. Menasha, Wis., 1941.

The following is the author's summary. Various methods of measuring deposits of spray oils are reviewed. All methods except one colorimetric analysis involve extraction of the oil from the sprayed surface with a suitable solvent, evaporation of the solvent and either volumetric or gravimetric measurement of the extracted oil. Both whole leaves and disks of known area have been used. Although the distribution of oil may not be uniform over the whole leaf, the disk method of sampling is considered adequate for measurement of relative results. Rapid loss of oil following application of field sprays necessitates either prompt extraction or storage of samples at low temperatures. It is doubtful whether relative deposits in field sprays can be inferred directly from laboratory measurements, since differences in the surfaces or conditions of application may change the relative quantities of oil deposited by different sprays.

Kagy (J. F.) & Boyce (A. M.). **Solubilizers for Petroleum Oils and Extracts of Rotenone-bearing Roots.**—*J. econ. Ent.* **34** no. 6 pp. 804–811, 5 graphs, 7 refs. Menasha, Wis., 1941.

The following is substantially the authors' summary. A method is described for the determination of the miscibility of the ternary systems of rotenone-bearing extracts, petroleum oils and solubilisers. For any solubiliser, a series of critical points was determined experimentally and plotted on triangular co-ordinate paper, giving curves that delimited homogeneous and heterogeneous mixtures. Three-component solubility curves were determined for systems of a light-medium oil, derris extract (33 per cent. rotenone) and solubilisers that are representative of different chemical classes, including diphenyloxide, oil of sassafras, methyl-n-amylketone, dibutylphthalate, 2(4-tertiary-butylphenoxy)

ethanol, Cardolite (a formaldehyde condensation product of cardanol, a constituent of cashew nut-shell liquid) and diamylphenol. It was found that the lower the unsulphonatable residue of a grade of petroleum oil, the greater the amount that can be added to a given solution of solubiliser and extract, that the more volatile fractions of kerosene have greater relative compatibility with solutions of extract and solubiliser than the heavier fractions, and that the compatibility of extracts of rotenone-bearing roots that differ in source is not a function of the rotenone content. Rotenone is much more soluble in solutions of a light-medium petroleum oil and 2(4-tertiary-butyl-phenoxy) ethanol when chemically pure than in the presence of the other constituents of the extract, and it is probable that some constituent in the extract other than rotenone is the chief factor in determining the compatibility of the mixtures. The desirability of knowing the composition of the phases that separate in the state of heterogeneity of the systems is emphasised ; within certain ranges of concentrations of the systems, a phase separates that appears to be one or more of the resins of derris root that are soluble in ethylene dichloride. Toxicological evidence indicates that certain heterogeneous compositions are effective for the control of certain insects, including *Aonidiella aurantii*, Mask., and *Saissetia oleae*, Bern., possibly because the active constituents of the extract are in solution.

Rohrbaugh (P. W.). **Physiological Effects of Petroleum Oil Sprays on** *Citrus*.—*J. econ. Ent.* **34** no. 6 pp. 812–815, 6 figs., 13 refs. Menasha, Wis., 1941.

The author reviews the effects of petroleum oils on *Citrus* and states that the injury caused by them is now considered to be due partly to chemical burning by the unsaturated hydrocarbon molecules or other toxic molecules in the oil and partly to the choking of the intercellular spaces and the surrounding of the plant cells with oils, which prevents the movement of gases such as carbon dioxide and oxygen out of and into the cells. The first may kill the cells of the leaves, causing leaf-drop, and also the cambium, causing local injury or, in some cases, the death of the tree, and is largely eliminated by using highly refined oils, most of which do not contain more than 6–8 per cent. unsaturated hydrocarbons. The second results in dormancy of the tree, some branches of which may eventually die. In work in 1937 and 1938, it was found that emulsions of the so-called soluble oils or oils containing oil-soluble spreaders spread out on the walls of the cells much more than emulsions with water-soluble spreaders. They tend to form thin films on the cell walls rather than globules in the intercellular spaces, but there is no evidence that either of these types is more injurious than the other.

Bartholomew (E. T.), Sinclair (W. B.) & Lindgren (D. L.). **Factors affecting the Absorption and Retention of Hydrocyanic Acid by** *Citrus* **Leaves and Fruits.**—*J. econ. Ent.* **34** no. 6 pp. 815–821, 5 figs., 5 refs. Menasha, Wis., 1941.

The following is substantially the authors' summary of this account of experiments carried out on Valencia oranges in California to determine whether fumigation injury is directly related to the amount of hydrocyanic acid gas absorbed in the tissues. Green and mature fruits absorbed decreasing amounts of HCN when preconditioned overnight at 43, 50, 65 and 80°F. Fruits sprayed with a 1 per cent. oil spray in the laboratory absorbed less HCN than unsprayed fruits, but similar tests with a 1·5 per cent. oil spray in the field showed no appreciable difference. Turgid fruits and leaves absorbed more HCN than non-turgid ones under field conditions, but not in the laboratory. Fruits from coastal areas absorbed more HCN than similar fruits from inland areas in 1939–40 and less in 1940–41, but in both years the coastal fruits were more

seriously injured than the inland ones. The amounts of HCN absorbed by fruits and leaves when fumigated under field conditions during the day or at night were approximately the same, but fruits and leaves fumigated during the day were much more severely injured than those fumigated at night. These results indicate that the stomata are not a controlling factor in the absorption of HCN. Whether or not the fumigated tissues will be injured appears to be governed by their physiological condition more than by the amount of HCN absorbed.

Sinclair (W. B.), Bartholomew (E. T.) & Ebeling (W.). **Comparative Effects of Oil Spray and Hydrocyanic Acid Fumigation on the Composition of Orange Fruits.**—*J. econ. Ent.* **34** no. 6 pp. 821–829, 1 fig., 15 refs. Menasha, Wis., 1941.

The following is substantially the authors' summary. Spraying orange trees in California with light-medium oils at concentrations of 0·25–1·75 per cent. caused a reduction in the total soluble solids and in reducing and total sugars of the fruit juice. Oil sprays reduced the soluble constituents in the fruit equally, with or without the addition of the other insecticidal substances tested. Although they had a tendency to reduce the titratable acidity, the results were not so decisive as in the case of the other soluble constituents. Since orange juice is highly buffered, the small change in titratable acidity of the juice was not sufficient to produce an effective change in the pH of the mature fruit. Only slight differences occurred in the composition of the juice of fruits from plots treated with sprays containing 0·75–1·75 per cent. oil. The data show that although the groves in which these experiments were carried out were widely separated and differed greatly in environmental conditions and soil types, the changes effected by the spray in chemical composition of the fruit were practically the same. The time of year at which the oil was applied was found to be relatively unimportant. Fumigating orange trees with hydrocyanic acid gas either in the autumn or in the winter had no marked effect on the chemical composition of the mature fruit.

Ebeling (W.). **Materials added to Oil Spray to increase its Effectiveness in *Citrus* Pest Control.**—*J. econ. Ent.* **34** no. 6 pp. 829–837, 20 refs. Menasha, Wis., 1941.

The following is based on the author's summary of this discussion of recent developments in the use of oils against pests of *Citrus*, mainly in California. Oil sprays, though increasingly important in the general pest control programme, have been nevertheless somewhat limited in insecticidal effectiveness, especially against certain pests. They can be made more effective by the addition of materials that improve them by physical or by chemical means. The physical means include improvement in emulsibility, spreading and oil-deposition on the tree and insect surfaces, by means of improved emulsifiers and spreaders. Walnut-shell flour and other finely-divided solids have been found to increase surface capillarity, making it possible for sessile insects to draw oil off the tree surface to their bodies to an extent not previously possible. The changes in the physical properties of oils by the addition of certain solutes has led to improvements by making possible preferential wetting, penetration control and other phenomena that promote a more efficient and extensive use of oil sprays. Materials added to oils may result in improvement of the resulting sprays by making possible the control of two pests, requiring different insecticides, with one spray treatment, by increasing the effectiveness of the spray because of the additive effect of the independent actions of two or more insecticides or because of the apparent synergistic action often resulting from combinations of certain compounds with oil even though these compounds may by themselves

have little or no insecticidal value against the pest in question, or by making possible the penetration of compounds that have a high independent toxicity but are not able to penetrate to the insect or into its body. Examples of materials added to petroleum-oil sprays that have been used either experimentally or in the actual control of pests of *Citrus* are given.

YOUNG (P. A.). **Physiological and physical Effects of Spray Oils on deciduous Trees.**—*J. econ. Ent.* **34** no. 6 pp. 838–844, 58 refs. Menasha, Wis., 1941.

This paper is a review of recent literature, the following being the author's summary. Petroleum oil sprays injure apple leaves by dwarfing or killing whole leaves, and by causing brown, purple, white, dry-green and oily translucent spots in the leaves. Oils may kill buds and interfere with proper colouring of fruit. The oils penetrate leaves quickly and pass between the cells and into the tracheae of the leaves and their twigs. Oils for use on apple leaves should be 83 to 90 per cent. unsulphonatable with viscosities of 70 and 80 secs. for most varieties of apples. For dormant sprays on apple, oils should be 60 to 70 per cent. unsulphonatable, with viscosities of 120 to 220 secs. Proper temperatures for application of oil sprays are 40 to 90°F. Oil emulsions may be applied at concentrations of 0·5 to 2 per cent. oil on leaves and 4 to 8 per cent. oil on dormant buds. Oils decrease transpiration of leaves. Respiration of leaves is increased or decreased by oils depending on the predominance of the chemical or the physical effect. Freezing of oil sprays on trees probably does not seriously change the effect of the emulsions. Effects of oil sprays are variable, depending on the species or varieties of plants, suffering of the plants from drought or fertiliser deficiency, load of fruit on the trees, number and concentration of sprays, sulphonatable residues and viscosities of the oils, type of emulsion, condition of leaves or buds and temperature of the air. Improper oil sprays may kill peach leaves, twigs and whole trees. Tank-mix emulsions must be extremely well agitated to be safe on trees.

SMITH (L. M.). **Toxicants used with Petroleum Oil Sprays for deciduous Fruits.** —*J. econ. Ent.* **34** no. 6 pp. 844–853, 74 refs. Menasha, Wis., 1941.

This paper comprises information, taken from recent literature, on the effect of adding insecticides to petroleum oil sprays. Such a mixture is classified as inhibitory, additive or multifold when its efficiency is definitely less than, approximately equal to or considerably greater than the sum of the efficiencies of its components. It is evident, however, from some of the experiments reviewed, that in most cases the data are insufficient to place a given combination in one of these classes; a method of computing the toxicity of a pair of poisons from the experimentally determined toxicities of the individual components in certain types of toxic action has been developed [*cf. R.A.E.*, A **28** 199], but it is not applicable to the majority of cases in which oil emulsion is combined with toxicants, since more than two toxic materials are usually involved.

HILLS (O. A.) & ROMNEY (V. E.). **A Method of simulating Airplane Application of Insecticides to tall Plants in experimental Plots.**—*J. econ. Ent.* **34** no. 6 pp. 853–856, 5 figs. Menasha, Wis., 1941.

The authors describe the construction of a scaffold that can be moved from one plot to another and enables insecticides to be applied from above to tall densely growing plants to simulate application from aircraft, and the method of operating it in the field. It was used successfully on small experimental plots of sugar beet grown for seed in Arizona in 1940.

FLETCHER (R. K.). **The Relation of Moisture Content of the Cotton Plant to Oviposition by *Heliothis armigera* (Hbn.) and to Survival of young Larvae.**—*J. econ. Ent.* **34** no. 6 pp. 856–858, 6 refs. Menasha, Wis., 1941.

An account is given of investigations to determine the relation between the succulence of cotton plants, as measured by the moisture content of the aerial part, and oviposition by *Heliothis armigera*, Hb., carried out in Texas in 1935–39. Counts of eggs on rows of 100 consecutive plants in representative fields of upland and lowland cotton were made at weekly intervals from the middle of June, and the moisture content of five average plants was determined by weighing them before and after drying, during the week in which the first rapid increase in oviposition occurred; in 1938 and 1939, the percentage moisture in the growing tips and the percentage of the total moisture of the plant contained in the tips were determined.

The correlation between the number of eggs and the average percentage water in the entire plant was not significant; that between the number of eggs and the percentage water in the growing tip was significant in 1939, but not in 1938; and that between the number of eggs and the percentage of the total moisture contained in the tip was highly significant in both years. In 1939, records of the number of first- and second-instar larvae on the remaining plants one week after the test plants had been cut showed a highly significant correlation between the number of larvae and the proportion of the water in the whole plant contained in the growing tip. The variation in the number of eggs and larvae on the different plants indicates that the more succulent cotton was more attractive to the adults and provided a more suitable environment for the survival of young larvae.

CRESSMAN (A. W.). **Susceptibility of resistant and non-resistant Strains of the California Red Scale to Sprays of Oil and Cubé Resins.**—*J. econ. Ent.* **34** no. 6 p. 859. Menasha, Wis. 1941.

In view of the promising results obtained in California with sprays of petroleum oil and cubé and derris resins for the control of *Aonidiella aurantii*, Mask., on *Citrus* [*cf. R.A.E.*, A **29** 426], tests were made on the relative susceptibility to such sprays of mature laboratory bred females of strains of the scale that are resistant and non-resistant to hydrocyanic acid gas. Artificially infested lemons were treated with sprays containing 1 per cent. of a combination of light medium oil and a solvent alone or with 0·006, 0·008 or 0·013 per cent. cubé resins containing 30 per cent. rotenone. Two methods of combining the resins with the oil were used; either 8 per cent. of a solution of the resins in a mixture of dibutyl phthalate and trichlorethylene (2 : 1 by volume) was added to the oil, resulting in a mixed solution and suspension of resins in oil; or 30 per cent. of a solution of the resins in dibutyl phthalate was added to the oil, resulting in a clear solution of resins in oil. The mixtures were emulsified with an equal volume of aqueous solution of ground bone glue. At the two highest concentrations of resins, the solutions were more effective than the mixed solutions and suspensions; the difference in the reactions of the two strains, however, was independent of the method of incorporating the resins. There was no significant difference in mortality between non-resistant and resistant scales sprayed with oil containing no resins, but the survival of the resistant strain was slightly but significantly greater (1·7–4·2 per cent.) after each treatment with oil and resins. Tests with sprays containing 0·0067–0·02 per cent. resins gave similar results. Although the difference in susceptibility of the two strains to sprays of oil and cubé resins was consistent, it was extremely small in comparison with the difference in susceptibility to HCN.

There was no difference in the effectiveness of sprays prepared by the two methods against Coccids that had matured in the field, but the mixture of

dibutyl phthalate and trichlorethylene is a better solvent for the resins than dibutyl phthalate alone.

Upholt (W. M.). **Chemical Control of** *Pseudococcus comstocki* **Kuw.**—*J. econ. Ent.* **34** no. 6 pp. 859–860. Menasha, Wis., 1941.

The distribution of *Pseudococcus comstocki*, Kuw., in South Carolina is restricted to one apple orchard. Although preliminary experiments on its control indicated that the ordinary sprays would not penetrate its waxy egg masses, which were present on infested trees throughout the year in 1940, it was observed that a fairly high concentration of Vatsol OT (a dioctyl ester of sodium sulphosuccinate) did so, but foamed too much to be practicable. Laboratory tests indicated that increasing the concentration up to at least 1 per cent. increased the ease of penetration, and it was found that a mixture of 1 gal. of a 70 per cent. solution of the ester with 500 gals. 3 per cent. dormant oil emulsion penetrated well without foaming in the apparatus used. On 24th May, when both egg masses and adults were rather scarce, 40–50 large heavily infested trees were sprayed thoroughly from the ground and from a spray tower with 1,500 U.S. gals. of a mixture containing 1 quart sulphosuccinate ester, 0·5 quart lauryl thiocyanate and 0·5 gal. summer oil emulsion per 100 gals., and no live mealybugs were found on the sprayed trees three days later, though unsprayed trees were heavily infested. In the middle of June, the second generation was hatching on the unsprayed trees and a few egg masses were found on two trees in the sprayed plot, which was, therefore, sprayed again on 26th June, when hatching was nearly complete, with the same materials at the same concentrations as before, incorporated in a regular cover spray of lead arsenate and lime. When the apples were harvested, the sprayed plot was practically free from mealybug damage ; adjacent trees were heavily infested until August, when the predacious Capsid, *Eurychilopterella luridula*, Reut., gave appreciable control. Apples in another plot in which the mealybugs were not controlled by the Capsid were badly damaged. The spray tested is too expensive to be recommended generally for economic control, but it could be used to eradicate an infestation.

Pyenson (L.). **Control of the Euonymous Scale.**—*J. econ. Ent.* **34** no. 6 p. 860. Menasha, Wis., 1941.

On Long Island, *Chionaspis euonymi*, Comst., which occurs on most *Euonymus* and bittersweet [*Celastrus*] shrubs, overwinters as a partly grown or full-grown female on the branches or evergreen foliage. Control during the growing season is difficult, since all stages are present at the same time, and dormant spraying with a miscible oil is not sufficiently effective. Spraying with a 2 per cent. solution of Elgetol [a water-soluble mixture containing sodium dinitro-cresylate] in early April 1940 resulted in almost complete mortality of the scales on heavily infested *Euonymus*, with no injury to the shrubs, which were still only very lightly infested in the following autumn. In the following April, spraying further shrubs with 1 per cent. Elgetol or with 0·5 per cent. Elgetol alone or with NNO (technical mannitan monolaurate) at concentrations of 1 : 1,600 or 1 : 200 gave 98·5, 56, 100 and 99·5 per cent. mortality, respectively, as compared with 20–25 per cent. on control shrubs. The spreader alone gave hardly any control. It is considered that single applications of the more effective sprays in the dormant season for two successive years should almost eradicate the scale. The effective concentrations of these sprays, applied in the dormant season, killed a large proportion of the overwintering eggs of the oyster-shell scale [*Lepidosaphes ulmi*, L.] on lilac, but some eggs always survived, owing to their position under the scales.

Richardson (C. H.) & Seiferle (E. J.). **Action of Derris and Rotenone on the Firebrat.**—*J. econ. Ent.* **34** no. 6 pp. 860–861, 3 refs. Menasha, Wis., 1941.

In preliminary experiments in Iowa, derris powder containing 4 per cent. rotenone and 14 per cent. total ether extractives or pure rotenone was incorporated in baits of rolled oats, sucrose and common salt (200 : 10 : 5) to give rotenone contents of 0·1–4 per cent., and individual adults of *Thermobia domestica*, Pack., were supplied with 0·03 gm. bait and kept at a temperature of 38°C. [100·4°F.] and a relative humidity of about 70 per cent. Derris baits containing 1 or 4 per cent. rotenone killed all the insects by contact within 24 hours, and those containing 0·5 and 0·1 per cent. killed 82 and 22 per cent., respectively, in 96 hours ; the rotenone baits were less toxic than the corresponding derris baits, except at the lowest content. There was practically no feeding on derris baits containing 0·1 per cent. rotenone and none on stronger baits, and there was much less on rotenone baits than on the control baits. It is considered that a derris dust containing 1 per cent. rotenone in a suitable carrier should protect stored papers, etc., from attack by *Thermobia*, where the use of other insecticides might be dangerous.

MacLeod (G. F.). **X-Ray Studies of starving Mealworm Larvae.**—*Ann. ent. Soc. Amer.* **34** no. 4 pp. 696–701, 2 pls., 2 refs. Columbus, Ohio, 1941.

The following is substantially the author's summary. From Grenz ray negatives of nearly full-grown larvae of *Tenebrio molitor*, L., visible evidence of some effects of starvation was obtained. The usual sequence of events appeared to be : the disappearance of food from the fore intestine ; the disappearance of food, excrement and water from the posterior part of the intestine ; enlargement and distension of the entire alimentary tract, occurring to a lesser degree in the rear than in the fore and mid-gut ; the appearance of an area in the middle part of the intestine that showed activity while the stored body fats of the larvae were being used as food ; and the distension of the intestinal tract by air or gas until it occupied almost all the body cavity.

Larvae that were completely grown pupated within one or two days when subjected to starvation. Some larvae had sufficient stored body fats to permit pupation, but only after several days' starvation during which they lived on their fat. All the larvae that pupated produced adults, that is, no pupae died as a result of larval fasting. Some larvae consumed their entire supply of fats and died before pupation. Starvation for less than a week did not produce permanent derangements of the intestinal tract that could be detected in radiographs. When larvae fasted for a week or 18 days they never fully returned to normal, although they pupated when fed and apparently normal adults emerged. These preliminary studies seem to indicate that mealworm larvae that have been starved until they begin to utilise their stored body fat cannot be considered normal specimens for exact physiological or toxicological studies.

Munro (J. A.). **Grasshopper Eggs and their larval Predators show high Degree of Survival.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **1** no. 3 pp. 3–4. Fargo, N. Dak., 1939. [Recd. 1942.]

Eggs of *Melanoplus mexicanus*, Sauss., laid during the preceding summer and blister-beetle and Bombyliid larvae, which are predacious on them, were collected from soil in North Dakota in early May 1938, covered with soil and stored in two groups at a temperature of 41–44° F. One group was kept in moistened soil and the other in soil that was allowed to dry. The viability of the eggs was 94 per cent. when they were collected. During August it was 80 and 30 per cent., respectively, under moist and dry conditions, and the difference

in survival of the predators appeared to be similar. On 18th November, 68 per cent. of the eggs were still viable, and 55 and 50 per cent. of the Bombyliid and blister-beetle larvae were living in the moist group, whereas neither eggs nor predators survived under dry conditions. Although the conditions of the experiment were probably more severe and prolonged than occur in nature, the results indicate that the same factors affect the development of grasshopper eggs and the survival of their predators, both being able to survive prolonged exposure to cold if they are provided with moisture.

Munro (J. A.) & Telford (H. S.). **The Grain Storage Insect Problem in North Dakota.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **3** no. 4 pp. 9–12, 1 map, 2 figs. Fargo, N. Dak., 1941.

Although insect pests of stored grain are seldom troublesome in North Dakota, owing to the dry climate and cold winters, samples of grain from elevators and farm bins have recently been examined to ascertain the occurrence and distribution of these insects, in view of the unusually large stocks of grain from previous years now held in store. *Laemophloeus minutus*, Ol., was by far the most common species, occurring in samples from 23 of 43 localities, while *Calandra* (*Sitophilus*) *granaria*, L., was obtained from 7 localities, grain mites from 5, and *Tribolium confusum*, Duv., from 4. Pests that were still less widely distributed comprised *T. castaneum*, Hbst., *Ahasverus advena*, Waltl, Psocids, probably *Liposcelis* (*Troctes*) *divinatorius*, Müll., *Oryzaephilus surinamensis*, L., *Ptinus fur*, L., *Palorus ratzeburgi*, Wissm., *Tenebrio molitor*, L., and *Pyralis farinalis*, L. Larvae and adults of *P. farinalis* are found in infested bins where the grain is fairly damp, and the larvae of *Tenebrio molitor* thrive in accumulations of grain, particularly if it is in contact with damp wooden flooring, but seldom cause appreciable injury to grain unless it is undisturbed for long periods, though they frequently damage the structure of the bins severely by burrowing into the wooden walls or floors. Instructions on the control of pests in stored grain include notes on the destruction of refuse grain and waste material, fumigation and the transference of grain from bin to bin during cold weather [*cf. R.A.E.*, A **30** 310].

Harris (R. H.), Sibbitt (L. D.), Munro (J. A.) & Telford (H. S.). **The Effect of the Green Grain Bug upon the Milling and Baking Quality of Wheat.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **3** no. 5 pp. 10–14, 2 figs., 9 refs. Fargo, N. Dak., 1941.

The Pentatomid that caused serious injury to wheat in North Dakota in 1940 and was then recorded as *Chlorochroa sayi*, Stål [*R.A.E.*, A **30** 97] has since been found to be *C. uhleri*, Stål. As the grains of wheat damaged by it are light and shrivelled, investigations were carried out to determine whether their milling quality and the baking qualities of the flour are affected. Preliminary tests having shown that the percentage of grains damaged in 13 varieties of wheat varied from 16·8 to 55·2, samples of three varieties, one of which was much more heavily damaged than the others, were subdivided into plump, intermediate and shrivelled kernels, milled and baked into bread. It was found that the weight of grain per bushel, the wheat protein content, the yield of flour and the volume of the loaf produced were reduced and the colour and texture of the crumb adversely affected by the injury.

Munro (J. A.) & Telford (H. S.). **Winter Survival of the Prairie Grain Wireworm at different Soil Depths.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **4** no. 1 p. 3. Fargo, N. Dak., 1941.

Larvae of *Corymbites* (*Ludius*) *aeripennis destructor*, Brown, the predominating wireworm in North Dakota, caged in the soil at depths of 3, 9, 12, 15 and 21

inches on 6th November 1940 were all alive on 12th May 1941, though air temperatures of from —15 to —22° F. were common during the colder part of the winter. The soil was protected by a covering of about a foot of snow, but froze below the surface. It is concluded that the depth at which wireworms pass the winter has no apparent effect on their survival.

Munro (J. A.) & Telford (H. S.). **Wireworm Populations as related to Potato Tuber Injury.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **4** no. 1 p. 4. Fargo, N. Dak., 1941.

Records of the average numbers of larvae of *Corymbites* (*Ludius*) *aeripennis destructor*, Brown, in soil samples taken to a depth of 1 ft. in potato fields in North Dakota during September 1940 and of the corresponding percentages of tubers injured by them are given in a table. They indicate that an average population of 1 wireworm per sq. ft. soil surface (approximately 43,560 per acre) is likely to result in nearly 43 per cent. injury to tubers.

Watson (J. R.) & others. **Entomology.**—*Rep. Fla agric. Exp. Sta. 1938–39* pp. 93–99. Gainesville, Fla. [1940.] [Recd. 1942.]

Some of the information in this report on entomological research in Florida in 1938–39 has already been noticed [*R.A.E.*, A **28** 364, 542]. Experiments in which *Frankliniella cephalica bispinosa*, Morg., was caged on orange confirmed previous evidence that a population of about 24 thrips per bloom often prevents the setting of fruit. The citrus aphis [*Aphis spiraecola*, Patch] became scarce owing to drought in the winter, and there was little food for the predacious Coccinellid, *Leis dimidiata* ab. *quinquedecimspilota*, Hope, in early spring, but its habit of feeding on members of its own species enabled it to survive. A colony of *Leptomastix dactylopii*, How., was obtained from California and bred in the laboratory for liberation against mealybugs [*Pseudococcus*] on *Citrus*. *Nezara viridula*, L., was only slightly more abundant in the peninsular part of the State than it had been in the preceding year [*cf.* **28** 151] and caused little damage to *Citrus*. Parasitism by *Trichopoda pennipes*, F., and other Tachinids during the autumns of 1937 and 1938 averaged about 40 and 45 per cent., respectively. Certain sprays and dusts of pyrethrum gave promising results against *Leptoglossus phyllopus*, L., which caused considerable local damage to satsuma orange.

As in previous years, *Thrips tabaci*, Lind., was not observed in the open during the summer, but onion sets from seed houses were heavily infested [*cf.* **28** 151]. The thrips also caused considerable damage to celery in one locality ; pyrethrum sprays gave the best control, although nicotine sulphate was fairly effective. Observations on the bionomics and control of *Taeniothrips simplex*, Morison, on *Gladiolus* were continued [*cf.* **30** 306]. *Anuraphis* (*Aphis*) *tulipae*, Boy., was found on growing bulbs of *Iris tingitana*, and *Aphis rociadae*, Ckll., on delphinium ; neither of these Aphids was previously known to occur in Florida. *Anthonomus eugenii*, Cano [*cf.* **26** 64] caused more injury to peppers [*Capsicum*] in Manatee County than for several years past, and has spread to Hillsborough and Charlotte Counties. It was observed for the first time to be damaging egg-plant [*Solanum melongena*]. A study of the bionomics of the Lygaeid, *Paromius* (*Orthaea*) *longulus*, Dall., a pest of strawberry, indicated that it attacks a number of plants, a list of which is given, and migrates between strawberry and native vegetation in accordance with the relative succulence of the plants.

Thompson (W. L.). **Control of Purple Scale and Whiteflies with Lime-sulfur.**—*Rep. Fla agric. Exp. Sta. 1938–39* pp. 145–147. Gainesville, Fla. [1940.] [Recd. 1942.]

Continued observations in Florida confirmed that *Citrus* that has received fungicidal and nutritional sprays containing compounds of copper, zinc and

manganese is more heavily infested by the purple scale [*Lepidosaphes beckii*, Newm.] than unsprayed ones or those receiving only lime-sulphur [*cf. R.A.E.*, A **28** 152, 471]. The increase of the Coccid is closely related to the amount of inert residue deposited on the leaves, although similar increases have followed the application of magnesium to the soil round trees. The lack of magnesium commonly results in reduced foliage and yellowing of the leaves, and heavy foliation resulting from corrective treatments also gives more protection to foliage on the inside of the tree and results in scale increase. *L. beckii* was more abundant on green leaves than on those suffering from zinc deficiency. A single oil spray gave satisfactory control of Coccids in 40 out of 45 plots following applications of copper sprays for disease control. The dormant copper sprays were supplemented with either wettable sulphur or oil emulsions containing 1 per cent. actual oil and the post-bloom sprays with wettable sulphur. The oil spray was applied in June and contained $1\frac{1}{4}$ per cent. oil when *L. beckii* alone was concerned, and $1\frac{2}{3}$ per cent. when the red scale [*Chrysomphalus ficus*, Ashm.] was also present. When both the dormant and the post-bloom sprays were supplemented with wettable sulphur and followed by the oil spray, no further control of the rust mite [*Phyllocoptruta oleivorus*, Ashm.] was necessary until December or later, but when sulphur was omitted from the dormant spray mite control was necessary by October. Better control of Coccids was obtained when the oil sprays were applied through relatively large apertures, probably because a larger stream of spray is more effective in turning the leaves and increases the coverage. Advancing the date of the oil spray to May resulted in improved control of mealybugs [*Pseudococcus*], which were then still in the crawler stage. Further confirmation was obtained that 4–5 applications per year of lime-sulphur (1 : 50) were more harmful to orange trees than an oil spray followed by two sprays of wettable sulphur or very weak lime-sulphur and wettable sulphur [*cf.* **28** 152]. The amount of dead wood following oil sprays was closely correlated with the amount of infestation by Coccids at the time the spray was applied.

WATSON (J. R.) & others. **Entomology.**—*Rep. Fla agric. Exp. Sta. 1939–40* pp. 72–76. Gainesville, Fla. [1941.]

Drought and abnormal cold in the winter of 1939–40 killed all flowers and resulted in a reduction in infestation of *Citrus* by *Frankliniella cephalica bispinosa*, Morg., in Florida, and little damage was caused. On the lower east coast, however, where the winter was not so severe, the thrips was very destructive to beans, both blossoms and leaves being attacked. The severe winter also resulted in a decrease in the numbers of *Leis dimidiata* ab. *quinquedecimspilota*, Hope, since *Citrus* growth and the green *Citrus* aphis [*Aphis spiraecola*, Patch] were both severely checked, but the Coccinellid is thought to have survived. Preparatory to importing from Porto Rico a Hymenopterous parasite [*Larra americana*, Sauss] of the West Indian mole-cricket [*Scapteriscus vicinus*, Scud.], *Hyptis atrorubens* and *Borreria verticillata*, the two chief sources of food of the adult wasps [*cf. R.A.E.*, A **29** 553], are being grown in several parts of Florida in which the mole-cricket is particularly destructive. A bait consisting of a mixture (1 : 16) of Paris green and a commercial dog food containing meat was effective against *S. vicinus*, and when put out in small pellets is not dangerous to cats and dogs. A colony of *Leptomastix dactylopii*, How., was liberated on *Citrus* in Sarasota County for the control of mealybugs [*Pseudococcus*].

A survey of the injury caused by *Collabismodes cubae*, Boh. [*cf.* **28** 364] showed that this weevil was present in small numbers in the Everglades and to the south of them, and became quite numerous in Dade County in the latter part of the season. It was more destructive to tomatos than to peppers

[*Capsicum*], and the destruction of both food-plants at the end of the season would seem to be the only feasible method of control.

THOMPSON [W. L.]. **Pest Control Studies. Effect of Fertilizers on Purple Scale Development.**—*Rep. Fla agric. Exp. Sta. 1939–40* pp. 158–160, 2 figs. Gainesville, Fla. [1941.]

In observations on the effect of soil fertilisers applied to *Citrus* trees on populations of the purple scale [*Lepidosaphes beckii*, Newm.] in Florida [*cf. R.A.E.*, A **30** 444], it was found that applications of magnesium in the form of dolomite resulted in increases in the percentage of green leaves, the density of the foliage and the numbers of the Coccid. Observations on grapefruit showed that scale infestation was lightest in plots receiving an acid inorganic fertiliser containing only nitrogen, phosphorus and potassium, and heaviest in those receiving zinc, copper and manganese together with magnesium oxide from magnesium sulphate. Apparently any fertiliser programme that maintains vigorously growing trees will indirectly influence scale development because of the high percentage of green leaves and the shaded conditions in well foliated trees, which favour the development of *L. beckii*.

THOMPSON (W. L.). **Combined Control of Scale-insects and Mites on Citrus.**—*Rep. Fla agric. Exp. Sta. 1939–40* pp. 161–163. Gainesville, Fla. [1941.]

Experiments carried out in 1939 on the control of insects and mites on *Citrus* in Florida showed that the purple scale [*Lepidosaphes beckii*, Newm.] continued to be more numerous following nutritional sprays that left heavy inert residues on the leaves [*cf. R.A.E.*, A **28** 471 ; **30** 444], but the difference was not significant when oil sprays were subsequently applied. In all cases where comparisons were possible, the rust mite [*Phyllocoptruta oleivorus*, Ashm.] was controlled for a longer period when wettable sulphur was used as the supplement for copper and zinc sprays than when an oil emulsion was used. An ordinary wettable sulphur was as effective as one containing an adhesive when used as a supplement to Bordeaux mixture or sprays of zinc sulphate and hydrated lime, but when neutral coppers having no adhesive qualities were used the wettable sulphur containing an adhesive agent was more effective. In experiments on grapefruit to determine the best time to apply oil emulsions for maximum control and at the same time to avoid injury to fruit and trees, the sprays were applied on five dates during the summer and the final scale inspections were made in December. In 1939, the most satisfactory general control was obtained from sprays applied during the first half of May, and the poorest results were obtained from the June sprays. As regards the population of *L. beckii* on the leaves in December, the July and early August sprays were as effective as the early May sprays, but in the plots sprayed in July and August insect injury had developed before the sprays were applied. Where the Florida red scale [*Chrysomphalus ficus*, Ashm.] was present, the early May spray was more satisfactory than the late May and early June sprays, but past observations show that reinfestation occurs by September and October unless thorough applications are made. In plots in which oil was applied in May or early June, there was a low percentage of pitted fruit due to *C. ficus* as compared with a high percentage following later sprays, while infestations by mealybugs [*Pseudococcus*] were low in plots sprayed in May. Where infestation by *Phyllocoptruta oleivorus* was low following sprays of copper and wettable sulphur, the early oil sprays extended the period of protection by 4–6 weeks; but where the oil sprays were delayed until July, the infestation developed to such an extent that the fruit was marked. No injury was caused by the early oil sprays on grapefruit, but injury developed on oranges sprayed early in May.

Investigations on the scarring of orange fruits by *Frankliniella cephalica bispinosa*, Morg., showed that most of the scars commonly attributed to thrips injury are caused by twigs and leaves rubbing against the young fruits during windy weather. When windbreaks were erected round individual trees before the blooming periods for three successive years, the fruit so protected was practically free of scars although the blossoms had been heavily infested with thrips, and a high percentage of fruit was marked on adjacent unprotected trees where the thrips population had been kept at a low level by sprays of lime-sulphur and nicotine sulphate. It was concluded that circular scars round the stylar end, and occasionally round the stalk end, were caused by the thrips, since such markings were absent from fruits from sprayed trees ; scars at the stylar end are seldom large enough to lower the grade of the fruit.

Report of Progress for Year ending June 30, 1940.—*Bull. Maine agric. Exp. Sta.* no. 400 pp. 185–294, 6 figs., many refs. Orono, Me., 1940. [Recd. 1942.]

This report includes notes by various authors on insect pests of crops in Maine in 1939-40. *Lymantria* (*Porthetria*) *dispar*, L., continued to cause widespread damage to woodland and apple trees during the summer of 1939 [*cf. R.A.E.*, A **29** 164], and studies in 1940 showed that the eggs were hatching from 16th to 30th May with a peak on 19th May, while drifting larvae were taken on adhesive screens between 27th May and 14th June, with a peak on 29th May. The catches showed that 95·6 per cent. of the drifting larvae carried into the orchards had reached them before the time of the calyx spray. Young larvae confined on leaves sprayed with lead arsenate in many cases refused to feed normally and eventually died, apparently of starvation. The apple race of *Rhagoletis pomonella*, Walsh, had a late and extended period of emergence in 1939, the first flies appearing in observation cages on 3rd July, eleven days later than in 1938. The unusually late production of large numbers of flies increased the difficulty of protecting apples from infestation, especially in orchards where the second fruit-fly spray was omitted. The addition of 3 U.S. gals. skim milk to the recommended fruit-fly spray of 2 lb. calcium arsenate, 6 lb. hydrated lime and 100 U.S. gals. water reduced the number of blotches of visible spray residue on the fruits and did not decrease the control. Preliminary tests with a solution of dichlorethyl ether and a wetting agent as a soil insecticide against the pupae gave unsatisfactory results.

Studies on the blueberry race of *Rhagoletis pomonella* [*cf.* **29** 165] were designed to test the value of an application of derris dust following two of calcium arsenate, since a third treatment with the latter, which is often made on productive fields, is injurious to the plants. The dust was a mixture of derris and pulverised clay and contained 2 per cent. rotenone ; it was applied on 7th August, but examination of the berries at harvest showed no reduction in infestation attributable to it. Dichlorethyl ether and carbon bisulphide emulsion applied to plots of blueberry land infested with *Frankliniella vaccinii*, Morg., in the early spring of 1939 failed to reduce the infestation.

The Mexican bean beetle [*Epilachna varivestis*, Muls.] now occurs throughout the greater part of Maine and continues to spread and to intensify its attack on beans. Areas where beans are grown for drying or canning have been invaded recently and suffered considerable damage. Beans can be protected from the Coccinellid by the use of calcium arsenate ; this arsenical is harmful to the plants when used alone, and the presence of arsenic on green beans is dangerous to consumers, though beans for drying, which are shelled, can safely be treated. In any case, calcium arsenate can safely be used before the pods have formed, but it requires the addition of some substance to safeguard the plants. Rotenone is almost as effective as calcium arsenate, but is more expensive and less durable in effect. In experiments in 1939 the yields of beans for drying were

increased, in comparison with untreated plots, by 4 applications at intervals of about 10 days, beginning on 19th July, of sprays of calcium arsenate with magnesium-bearing lime, alone or in Bordeaux mixture, or with ordinary lime, and of dusts of calcium arsenate with copper sulphate and lime (magnesium-bearing) and magnesium arsenate in talc, the latter giving the greatest percentage increase of any treatment. Reduced yields followed the application of dusts of calcium arsenate, copper sulphate and ordinary lime, and of calcium arsenate, magnesium-bearing lime and a dry spreader.

The yield of cucumbers dusted with a mixture of calcium arsenate (1 : 20) for the control of *Diabrotica melanocephala*, F. (*vittata*, F.) was increased by substituting magnesium-bearing for ordinary lime as the diluent. In untreated plots several plants were killed outright by the infestation. Squash plants near the experimental cucumbers attracted large numbers of beetles, and it is suggested that squash might be effective as a trap-crop ; beetles collecting on it should be killed by regular applications of a strong contact spray. Infestation of squash by *Anasa tristis*, DeG., has become serious in Maine. In experiments, squash plants treated with a dust of calcium arsenate and magnesium-bearing lime for the control of *D. melanocephala* followed by three applications of a stabilised pyrethrum dust for the control of *A. tristis* gave a considerably higher yield than untreated plants. A much smaller increase in yield followed the use of ordinary lime with the arsenate.

The pea Aphid [*Macrosiphum onobrychis*, Boy.] was present in comparatively small numbers on canning peas during 1939 ; predators and parasites played an important part in preventing it from reaching outbreak proportions, but it was almost exterminated by a disease, thought to be caused by a fungus [*cf.* **29** 165]. This disease spreads very quickly after the Aphids have become abundant enough to be in contact with one another. Environmental studies showed that outbreaks of the Aphid occur during hot weather ; warm fair weather favours its predators and parasites, and warm humid weather the disease. The Aphid was observed on clover in the autumn of 1939 and in May–June 1940.

WARD (I. J.). **The Bean Weevil,** *Acanthoscelides obtectus* **(Say) in stored White Beans.**—*Canad. Ent.* **73** no. 11 p. 216. Guelph, Ont., 1941.

A jar containing rather more than a pint of white beans lightly infested by *Bruchus* (*Acanthoscelides*) *obtectus*, Say, was kept in a sealed container at room temperatures in British Columbia, and the beans and Bruchids were counted after a year. Of a total of 1,841 beans, only 65 were not infested. The number of Bruchids that had emerged was estimated from their weight to be 14,557, and 5,328 were still in the beans. The total population of 19,885 Bruchids represents an average of 11·2 per bean, and this is regarded as practically the maximum possible infestation, since all the available food had been used.

BALCH (R. E.), REEKS (W. A.) & SMITH (S. G.). **Separation of the European Spruce Sawfly in America from** *Gilpinia polytoma* **(Htg.) (Diprionidae, Hymenoptera) and Evidence of its Introduction.**—*Canad. Ent.* **73** no. 11 pp. 198–203, 17 refs. Guelph, Ont., 1941.

The authors summarise the work [*R.A.E.*, A **29** 474, etc.] that has led to the separation of the spruce sawfly [*Gilpinia hercyniae*, Htg. (*cf.* **30** 341)] that occurs in Canada as well as Europe and reproduces by thelytokous parthenogenesis from *G. polytoma*, Htg., which occurs in Europe and reproduces by arrhenotokous parthenogenesis, and discuss the reasons for considering it to have been introduced into Canada. These reasons are the shortness of the time for which it has been known in North America, where specimens were taken in Ontario in 1922 and New Hampshire in 1929, although the outbreak in the Gaspé Peninsula was not discovered until 1930 [**20** 590], its distribution and

the spread of the outbreak, the almost complete failure of native parasites to attack it [**28** 416], and the existence in Europe, but not in America, of a closely-related bisexual form from which it may have been derived or which may have had a common progenitor [*cf.* conclusion of next abstract]. Where a form that produces only females arises, it is likely to compete successfully with one that produces both sexes and, under conditions unfavourable to mating, will replace it, especially if small numbers of individuals are carried into new areas. The bisexual habit is then unlikely to re-appear, since the offspring resulting from the union of diploid ova and haploid spermatozoa [**26** 215] would be triploid and probably sterile. In the case of *G. hercyniae*, the presence of a spermatheca in the female and fully-developed testes in the male indicate that reproduction was originally bisexual, but the occasional attempts at mating that were observed during studies with *G. hercyniae* in Canada were unsuccessful.

In view of its thelytokous reproduction, populations of *G. hercyniae* in Canada should exhibit uniform characteristics, and this has been demonstrated for morphology, variations in size being due to variations in the food-plants and feeding conditions. The tendency towards diapause and the production of males varies considerably, however ; in the Gaspé Peninsula, where the season permits the development of only one generation, the tendency towards diapause is high, probably as a result of natural selection, but further south, where two or more generations are able to develop, it is less frequent [**30** 341].

Prebble (M. L.). **The Diapause and related Phenomena in *Gilpinia polytoma* (Hartig). III. Bioclimatic Relations.**—*Canad. J. Res.* (D) **19** no. 11 pp. 350–362, 5 figs., 10 refs. Ottawa, 1941. **IV. Influence of Food and Diapause upon Reproductive Capacity.**—*Op. cit.* no. 12 pp. 417–436, 1 fig., 11 refs. **V. Diapause in Relation to Epidemiology.**—*T.c.* pp. 437–454, 5 refs.

These three papers complete a series of which the others have already been noticed [*R.A.E.*, A **30** 341–344]. In the first of them, an account is given of the relation between the number of generations produced each year by *Gilpinia hercyniae*, Htg. (*polytoma*, auct.) in different parts of Canada and the climatic conditions in those areas. The studies were carried out in the central part of the Gaspé Peninsula, where there is one generation a year, and south-central New Brunswick, where there are two, and the topography and climate of each are briefly described. The results of observations on development within cocoons overwintering in the undisturbed moss and in shallow containers under the moss among black and white spruce [*Picea mariana* and *P. glauca*] growing on flat ground and on slopes in Gaspé, are given in tables and graphs, which also include climatic data. These observations indicate that the resumption of development after diapause is controlled by factors that operate before mid-June, since larvae that had not resumed development by the latter half of that month rarely did so later in the season, even though precipitation was abundant and the temperature of the soil higher in July and August. The percentage of seasonal development can therefore be reliably estimated two or three weeks before emergence begins. There is no tendency to produce a second generation ; in eight years, only two adults emerged in the summer from many thousands of reared and field-collected newly-spun cocoons, although development was occasionally continued beyond the stage at which it normally ceases for the winter. In New Brunswick, where the growing season is nearly two months longer and the mean air temperature in the middle of it about 9°F. higher than in Gaspé, no such estimate of seasonal development is possible, because, although emergence from overwintered cocoons is normally complete by July, it may continue throughout the season when the resumption of development is retarded by dry spring weather.

On the basis of biological and meteorological data from numerous stations throughout the infested region of Canada and the United States, the author and A. W. A. Brown tentatively divide this territory into zones according to the number of generations that occur or are likely to occur there during the year. Since the influence of rainfall is comparatively unimportant, only temperature characteristics were considered ; the index selected was the sum of monthly mean temperatures above 43°F., which is close to the threshold for development within the cocoon, incubation and larval feeding in *G. hercyniae*. The method is open to criticism, but is justified by the agreement between the deductions from analyses of climatic data and the facts in a number of localities for which biological data are available. These localities include, in addition to the Gaspé Peninsula and south-central New Brunswick, the border country between Quebec and Ontario, where a partial second generation is produced [**26** 534, 538], south-western Maine, where there is a partial third [**29** 637], and Connecticut, where there are three generations [*cf.* **25** 558]. It was found in New Brunswick that there is practically no emergence from the later cocoons of the first generation, and the percentage emergence in samples received by the Forest Insect Survey from places south of 48°N. lat. by early August, and from places farther north, where development is much later, throughout the season, was therefore employed as a further index. On these bases, five zones were distinguished and are shown on a map. Where the sum of the effective temperatures does not exceed 65 and the emergence value 3 per cent., there is only one generation a year ; where the sum is 81–100 and the emergence value exceeds 40 per cent., there are two, and where the sum exceeds 115, there are three. There are also the two transitional zones with intermediate temperature sums ; one of them allows the production of a partial second generation normally or in favourable seasons, the emergence value usually being below 25 per cent., and the other is only tentatively established on the probability that a partial third generation occurs in areas climatically similar to south-western Maine. Instances are quoted to illustrate the factors considered in classifying localities for which the biological and climatic data were not in accord.

In the second paper, an account is given of experiments on the influence on reproductive capacity of factors, especially of diapause, that act during larval development. No consistent relation was established between the number of ova produced and the longevity of the female, or between either and the percentage of eggs deposited. Since, in addition, females emerging after prolonged diapause were as vigorous as others that had not passed through a resting period and the percentage of hatch in both Gaspé and New Brunswick has generally exceeded 90 per cent., the determination of the influence of food and diapause was restricted to a study of the number of oöcytes capable of development to maturity. This number was determined by counting the oöcytes in newly-emerged females, since studies established that the statistical difference between values obtained in this manner and those obtained from the number of eggs deposited and oöcytes retained by each female was negligible, although some evidence of the absorption of small numbers of oöcytes during adult life was obtained. No correlation was observed between the percentage of immature oöcytes at adult emergence and the duration of diapause or the total reproductive capacity, and there was no evidence of a tendency for more and less fecund individuals to emerge at restricted intervals during the emergence period and no significant difference in the degree of variability among individuals emerging at different times. The gross weight of the cocoon and its contents immediately after its construction, the head width of the adult and the length of the cocoon were all significantly correlated with reproductive capacity, the highest correlation being that for gross weight. It was found, however, that although size and fecundity vary directly under the influence of food and other factors during larval development, they do not vary to the same degree in different populations. Females reared from larvae collected on

white spruce were larger and more fecund than those from black spruce ; their mean reproductive capacity frequently exceeded 50, and occasionally 60, and lower values were due to unsatisfactory feeding conditions, whereas the reproductive capacity of females from black spruce reached 50–55 only under excellent feeding conditions and fell below 40 where suitable foliage was scarce. When fourth-instar larvae collected in the field were deprived of food for alternate intervals of two or three days, the reproductive capacity of females that developed from them was reduced by 27–37 per cent. Experiments with pure lines, reared without diapause in an incubator, established that the fecundity of the offspring is not necessarily related to that of the parents.

The effect of diapause on fecundity was studied among populations each consisting of individuals collected at one time from one species of food-plant over an area generally less than one acre in extent, since the correlation between diapause and fecundity varied in different populations. There was no relation between mortality during diapause and fecundity, since in populations from which emergence continued for five successive years, those females that remained longest in diapause showed no tendency towards greater or less fecundity. The distribution of females within the range of variation in reproductive capacity was not constant in successive years, but in only one of 20 populations studied was there a progressive reduction in reproductive capacity, as would be expected if there were any appreciable metabolic demands during diapause. Some evidence was obtained that resumption of development may not affect more or less fecund members of the population at random, but may be biased towards one or other group by unknown factors. Confirmation of the small metabolic demands made during diapause was provided by measuring the dry weight of individuals at the beginning of and at intervals during that period ; no significant difference was noted.

In the third paper, the author discusses the direct and indirect influence of diapause on epidemiology in different parts of the sawfly's range in eastern North America, where the variable factors are the percentage of diapause in overwintered cocoons, the number of years passed in diapause, the ultimate survival, and the number of generations produced during the year. In Gaspé, observations were made on field-collected cocoons, comprising a mixture of generations, and reared cocoons of a single season kept in containers placed under the moss in the forest between September and June and on the forest floor in a shaded place during the summer. Emergence was rarely complete in less than four years, and generally required five or six ; occasionally it extended into the seventh year. Prolonged diapause occurred to equal extents among mixed field populations, batches of cocoons spun at the same time, and the progeny of single females. There was a tendency for emergence from these cocoons and also from others in the undisturbed forest floor to be reduced in the second year after the construction of the cocoons and increased in the third or fourth, regardless of the calendar year in which the cocoons were formed. Adults emerged from approximately 50 per cent. of the total number of cocoons ; about half appeared in the first year, and most of the rest in the third and fourth years. Among overwintered cocoons collected in different types of forest in late spring, the percentage containing individuals that continued to diapause varied from 30 to over 95 ; the percentage was not constant year by year in contiguous areas, and is thought to be influenced by factors other than climatic ones. In several series in which larvae matured under conditions of gradually decreasing temperature, emergence in the following season was significantly higher among the later ones to mature, but there was no progressive increase in emergence when successive batches of larvae matured in the absence of a definite temperature decline. The degree of diapause is characteristically high in this region, and the variation exhibited by populations of different stands and years appears to be largely due to their previous history, and not to variations in climate. In a discussion of the relation of diapause to the progress of

the outbreak in Gaspé, it is stated that the average survival rate is 15 per cent. in white spruce on level ground and 32 per cent. in black spruce on slopes, and this rate is likely to continue unless new methods of control are introduced. As a result of the low survival rate and high degree of diapause in regions where there is one generation a year, infestations develop fairly slowly but are persistent, and the only factor that causes a steady decline is severe defoliation, resulting in the loss of 90 per cent. or more of the old foliage, and the death of the food-plant.

The results obtained in New Brunswick are not entirely typical of field populations, since most of the material was kept in wood-covered containers during the summer and it was later found that in this region lack of moisture during this period may prolong the diapause. Adults emerged from 84 per cent. of the original number of cocoons; emergence extended over three years, and the average percentage of the total in successive years was 64·5, 24·1 and 11·4. About 8–40 per cent. of the overwintered cocoons remained in diapause throughout the season, but in two counties in the north of the Province this percentage was increased to 19–70, and H. B. Peirson and R. W. Nash found that in northern Maine in 1939, 35 per cent. of the overwintered cocoons remained in diapause. In a description of the course of the outbreak in New Brunswick, populations are stated to have been low in 1933 and to have remained low for two or three years, but to have shown considerable variability in later years. The survival rate varies considerably in different localities, and the average for 1939–40 ranged from 32 to 82 per cent.; a larval disease [**29** 38] and introduced parasites were responsible for a marked decrease in two localities. Other workers estimated the percentage survival in 1939 in parts of central and northern Maine to be 23–58. In these regions, infestations are often localised, but build up rapidly and often cause severe defoliation within a year or two.

Data on diapause and epidemiology in southern New Hampshire and Vermont, where a partial third generation usually occurs, were supplied by R. C. Brown, P. B. Dowden, and W. F. Sellers. In 1938–39, the percentage of overwintered cocoons remaining in diapause in one locality in New Hampshire and two in Vermont varied from less than 1 to 15, and the percentage of diapause among first-generation cocoons in one of the places in Vermont in 1939 was 12–13. Survival averaged 57 per cent. at this place and 70 per cent. in New Hampshire. Infestations were more or less localised in these States; the populations in some districts reached enormous numbers in 1939, greatly exceeding those in Gaspé or New Brunswick, but were later considerably reduced by disease. The rapid increases in population result from the combination of a low percentage of diapause in overwintered and first-generation cocoons, fairly high survival, and increased number of seasonal generations, but the fewness of the cocoons in diapause renders the population susceptible to violent reduction by factors that affect the feeding larvae.

In a concluding section, the author discusses the question of intraspecific differences. It was suggested in a paper already noticed [**29** 474] that the arrhenotokous *G. polytoma*, Htg. (6 chromosomes) and the thelytokous *G. hercyniae* (7 chromosomes) arose from a common facultatively parthenogenetic prototype with 7 chromosomes, since the basic chromosome number of allied species was found to be 7. It is probable that *G. hercyniae* was to some extent heterozygous at origin, and so would inevitably become split into races as a result of the self-fertilising mechanism, the inhibition of sexual reproduction due to the scarcity of males and the probability that infertile triploids would result if any pairing occurred [see preceding abstract], and the inhibition of interbreeding with the arrhenotokous form owing to the difference in chromosome number. Differences in the tendency towards diapause were noted in pure lines of *G. hercyniae* in Canada; furthermore, in laboratory stocks a higher proportion of males was produced in emergent lines than in diapause lines

or than in field populations. The increase in number of males in laboratory stocks is believed to be caused by an acceleration, due to higher temperatures, in the rate at which the second polar body is budded off from the female pronucleus, so that auto-fertilisation is prevented. Since emergent and diapause lines are both present, though in different proportions, in areas with one and two generations a year, it is concluded that climate is only partly influential in determining the composition of the population. No strongly emergent lines have been found in Gaspé, though the likelihood of partial survival, as a result of diapause induced by the environment, of emergent stock introduced there has been demonstrated [**30** 341], and diapause lines appear to have no intrinsic handicap in two-generation areas, where, however, they become outnumbered as a result of their slower rate of increase.

Gobeil (A. R.). **La diapause chez les tenthrèdes. Partie I.**—*Canad. J. Res.* (D) **19** no. 11 pp. 363–382. Ottawa, 1941. **Partie II.**—*Op. cit.* no. 12 pp. 383–416, 121 refs.

These two papers comprise a detailed account of statistical studies of the factors that influence the breaking of the diapause in Tenthredinids, undertaken in 1938–41 in view of the severe outbreak of *Gilpinia hercyniae*, Htg. (*Diprion polytomum*, auct.) on spruce in eastern Canada. In the northern part of this region, diapause in this species may extend over as many as six or seven years. In the first paper the author reviews previous work on diapause from the literature and, after giving brief accounts of the bionomics of *G. hercyniae* and *Pristiphora erichsoni*, Htg., the two principal species studied, describes experiments on the influence of the temperature and humidity of the air on breaking diapause. In 1938–39, material obtained from almost every county in Quebec was employed, but this method was found to be unsuitable, and the investigations in 1940–41 were confined to 50,000 cocoons of *G. hercyniae* collected at one place on August 26th and 25,000 cocoons of *P. erichsoni* collected between 20th August and 1st September. Mortality among larvae of *G. hercyniae* during diapause was not influenced by the duration of the resting period (42–112 days) or the temperature at which it was passed (15, 34 or 45°F.), but some larvae that had passed through diapause at 15°F. could not be induced to resume development at the temperature and relative humidities at which pupation normally takes place. The lower temperature limit for Tenthredinid larvae in diapause seemed to lie between 0 and 15°F.; exposure to a temperature of 0°F. for 10 weeks resulted in complete mortality among larvae of *G. hercyniae*. Mortality among pupae of *G. hercyniae* was lowest and emergence of adults highest when diapause took place at 34°F. and the pupal stage at 75°F. and 85 per cent. relative humidity. The percentage mortality during the pupal stage was influenced to a greater extent by moisture than by temperature, and was lower at 85 than at 75°F. when the latter temperature was associated with dry conditions; at relative humidities of 20–30 per cent., the cocoons become hard and many adults are unable to gnaw their way out. Low temperatures during diapause had a greater influence on the degree of mortality during the pupal period when they were associated with dry than with wet conditions. In all the species studied, development after diapause was resumed at temperatures as low as 60°F. Atmospheric moisture appeared to have little effect on the resumption of development after diapause but is of importance in determining the degree of emergence. Abrupt changes in temperature at the beginning or end of diapause did not reduce vitality during the pupal stage, but emergence was considerably reduced when larvae were subjected to high temperatures at the beginning of diapause, whereas emergence was higher when the change in temperature at the end of diapause was abrupt than when it was gradual. Evidence was obtained that a period at low temperatures during diapause is necessary for the resumption of development.

Cocoons of *G. hercyniae* and *P. erichsoni* in the field are frequently in contact with water, which is generally acid, and investigations on the effects of immersion in distilled water [*cf. R.A.E.*, A **30** 342] and in solutions of sulphuric or aminoacetic acid were therefore carried out and are described in the second paper. At 34°F., complete mortality was obtained in *G. hercyniae* only after the cocoons had been immersed in water for 26 days, but at 75°F., mortality was complete after only 8 days. Since the pH of humus in forests in Quebec is stated to range from 3·5 to 6·0, acid solutions of pH 3 and 5 were used in the experiments ; in the case of aminoacetic acid, the solution was buffered with acetic acid in order to obtain a pH value of 3. When cocoons of *G. hercyniae* were immersed during diapause for two consecutive hours each week in water or in a solution of sulphuric acid, there were no apparent injurious effects on the larvae, but when they were immersed in a solution of aminoacetic acid for the same period, or in water or a solution of sulphuric acid for three periods of one hour each a week, the percentage mortality was increased ; when the diapause exceeded six weeks, immersion for three hours weekly in any solution or for two hours in one of aminoacetic acid caused considerable mortality. The results of similar tests with *P. erichsoni* were inconclusive, since the cocoons are more susceptible to injury during manipulation, to which much of the observed mortality was probably due.

The mortality of pupae of *G. hercyniae* in cocoons that had been immersed in water was greater when the duration of diapause was 56 days or more than when it was only 42 ; diapause in the field generally exceeds 56 days. Mortality was greater when the cocoons were immersed during both diapause and the pupal stage than when immersion took place only during diapause ; in the latter case, mortality following immersion for two or three hours weekly was only slightly higher than when there was no contact with water. The effect of immersion in solutions of sulphuric acid was not significantly greater than that of immersion in water, but high mortality followed contact with solutions of aminoacetic acid. Mortality was not influenced by the pH values (3 and 5) of the solutions employed. Emergence was greater after immersion in solutions of sulphuric acid for two consecutive hours than for three periods of one hour each per week, and during diapause than during the pupal period ; maximum emergence was obtained after immersion during both stages. Development was more easily resumed after contact with water during diapause, and there was still greater emergence after immersion in a solution of sulphuric acid (pH 3) during both diapause and the pupal period, but emergence was reduced considerably when a solution of aminoacetic acid of the same pH value was used. Emergence was significantly greater after immersion in sulphuric acid solutions of pH 3 than of pH 5.

Details are also given of tests in which cocoons were immersed in concentrated sulphuric acid for brief periods ; it is concluded that such immersions facilitate the breaking of diapause, the action being due to chemical shock and not to desiccation.

The influence of different environments on the rate of development during the pupal period in *G. hercyniae* was determined from statistical analyses of the data. It appears to be independent of the temperature at which diapause occurs when this is in the region of 15–32°F., but is retarded when diapause takes place at high temperatures (45°F.). The resumption of development is no more rapid after 12 than after 16 weeks of diapause, but increases with rises in the temperature during the pupal period until the upper vital limit is reached. Abrupt changes from temperatures characteristic of diapause to those of pupation did not influence the rate of development, and the speed with which metabolism was resumed did not appear to be affected by relative humidities between 56 and 85 per cent. In general, immersion in water favoured accelerated development, but in some cases, notably when it occurred only during the pupal stage, caused a retardation.

In a discussion of the results, the author concludes that the resumption of development is not influenced to any great extent by the climatic conditions prevailing at the time of metamorphosis. The length of diapause in different regions is more likely to be determined by climatic factors operating during the egg and active larval stages, when climatic conditions in different districts show most variation, than during the cocoon stage, when they are fairly constant throughout the infested area.

FALLIS (A. M.). **The Life Cycle of *Apanteles carpatus* (Say) (Hymenoptera: Braconidae), a Parasite of the Webbing Clothes Moth, *Tineola bisselliella* Hum.**—*Canad. J. Res.* (D) **20** no. 1 pp. 13–19, 1 pl., 4 figs. Ottawa, 1942.

A laboratory colony of *Tineola biselliella*, Humm., in Toronto was decimated as a result of parasitism by *Apanteles carpatus*, Say, and naturally parasitised larvae were found in three other parts of the city. Observations on the bionomics of this Braconid showed that it reproduces parthenogenetically and is thelytokous, no males being observed. In the laboratory, the adults were kept at about 20°C. [68°F.] in separate vials containing absorbent cotton partly moistened with honey, and a large number survived for 2-3 weeks. Many drank readily when drops of water were provided. They were attracted to light, especially just after emergence, and probably locate the host, which frequents dark places, by means of touch or smell; host larvae were most readily attacked when they were encased, especially if the cases were made of faecal pellets, and empty cases or even single pellets were sometimes attacked. The females sometimes oviposited on the day of emergence. The eggs were laid in any part of the host, and although several were laid in a single host and all usually hatched, only one larva completed its development.

The minimum and maximum durations of the egg and larval stages together were 13 and 45 days at 27°C. [80·6°F.], and 20 and 154 days at 24°C. [75·2°F.]; at room temperatures, development lasted several months. The pupal stage averaged 8 days at 27°C. On leaving the host, the parasite larva pupates in a silken cocoon spun inside the case of the host; it is unable to spin a cocoon if the host is not in a case, and few of such larvae gave rise to adults. A relative humidity of 30 per cent. appeared to be the most favourable for both larvae and pupae; that most suitable to the host has been shown to be 75 per cent. [*R.A.E.*, A **24** 657]. Notes on the morphology of the larva are included.

[TZITZIN (N. V.).] **Цицин (Н. В.). Pyrethrum.** [*In Russian.*]—80 pp., 26 figs. Moscow, Sel'khozgiz, 1941. Price 1 *rub.* **Dalmatian Pyrethrum.** [*In Russian.*]—40 pp. Moscow, Moskovsk. Rabochiĭ, 1941. Price 55 *kop.*

In the first of these booklets, it is stated that *Chrysanthemum* (*Pyrethrum*) *cinerariaefolium* was introduced into the Russian Union in 1935 and is now being cultivated widely as a source of pyrethrum for use in insecticides. Directions are given in the first part for its cultivation and harvesting and for the preparation of dusts, suspensions and extracts, and the chemical evaluation of the pyrethrin content of the flowers and the preparations made from them. The second part (pp. 37–61) contains information on the use of pyrethrum dusts or sprays against insect pests of cultivated plants and insects and mites in stored grain, the species discussed being selected as typical of many others that can be similarly treated. The third part (pp. 61–78) deals with the control of pests of domestic animals.

The second booklet is intended for the use of workers on collective farms in the Moscow region, and is a more popularised version of the first two parts of the first one. It also includes notes on precautions to prevent bees from being poisoned when visiting treated crops.

Wireworms and newly ploughed Grassland. Suggestions in Respect of Cropping. —*Agriculture* **48** no. 3 pp. 172–176, 2 refs. London, 1941.

This paper comprises suggestions for the cropping of fields of known wireworm populations in the several agricultural provinces of England and Wales, based on conclusions drawn from extensive soil sampling in all parts of the country during the winter of 1940–41 and observations made on the crops in the sampled fields during the subsequent growing season [*cf. R.A.E.*, A **30** 270]. In the first year after grass, practically all crops were successful when the wireworm population was not greater than 300,000 per acre, though potatoes were unsatisfactory, even where the population was very low. Adequate crops of most kinds were produced where the population was 300,000–600,000 per acre, but special care (proper consolidation, adequate manuring, increased seeding rates, etc.) was needed. There is considerable risk of heavy damage to certain crops where the population is 600,000–1,000,000. In the southern, eastern and central areas, where such populations are common, many of the usual crops are recommended, in spite of the risk of injury; but in the north, where such high populations are unusual but very injurious, resistant crops should be grown. If wireworm populations exceed a million per acre, only highly resistant crops, such as beans, peas, mustard, linseed and silage mixtures, should be grown, or the land should be ploughed to begin the dispersal of wireworms and reseeded with grass and clover.

Cultivation appears to be important in preventing injury; ploughing should be done thoroughly shortly before seeding, the turf properly buried and the land consolidated. The use of a disk harrow in summer exposes wireworms to attack by birds and breaks the cells of the pupae, but severe loss has occurred on land treated in this way, probably because the turf was broken into small pieces that disintegrated and left the wireworms without food.

Miles (H. W.), Petherbridge (F. R.) & Jary (S. G.). **Wireworms and Agriculture.**—*J. R. agric. Soc. Eng.* **102** pp. 171–188, 7 figs., 21 refs. London, 1941.

H. W. Miles gives a brief account of the life-history of wireworms in Britain, where they are usually less numerous in arable land than in grassland, because the latter provides abundant food, more stable conditions of temperature and moisture and practically no disturbance during the life-cycle [*cf. R.A.E.*, A **28** 156]. He describes the damage they cause to cereal, root, market-garden and pulse crops, discusses the effect of wireworm populations of different sizes on agricultural practice and gives a key for the identification of wireworms and the larvae of other insects that commonly attack cereal seedlings. Accounts of observations on wireworms in the north-west, east and south-east of England, by H. W. Miles, F. R. Petherbridge and S. G. Jary, respectively, include details of the populations that may be expected in these regions and alternative cropping plans suitable for ground supporting different populations [*cf.* preceding abstract].

von Zehmen (H.). **Ein Beitrag zur Frage der Anlockstoffe weiblicher Falterschädlinge.** [A Contribution to the Question of the attractive Substances secreted by female Moth Pests.]—*Zbl. ges. Forstw.* **68** pt. 3 pp. 57–64, 13 refs. Vienna, 1942.

An account is given of preliminary experiments in 1938–39 at Tharandt on the effect on males of *Lymantria dispar*, L., and *L. monacha*, L., of the specific attractants secreted by the females [*cf. R.A.E.*, A **28** 36, etc.]. The material was obtained by removing the last three abdominal segments of females that

had emerged 2–3 days before and extracting them for at least 2 days in benzene in a corked bottle. The solvent with the segments in it was poured over absorbent material which was exposed to attract the males. The tests with *L. dispar* were made in stands of spruce to ensure that no example of this species was present except those brought there for experiment. Males released about 60 ft. away were attracted more by the extract than by living females. The benzene vapour charged with the attractant appears to sink, as the males gradually fluttered about near ground-level. Benzene by itself was not attractive, nor was an extract made with carbon tetrachloride. Extracts in alcohol (95 per cent.), chloroform, acetone or ether were about as effective as benzene extract. Ether extract was especially attractive ; the solution was light green in colour, whereas the solutions made with the other solvents were colourless. After complete evaporation of the solvent, all the extracts had a faint smell of fresh cucumber juice. In the case of *L. monacha*, L., the extracts were much less effective than living females. Various possible reasons for this failure are suggested. The author discusses the possibility of producing these attractants synthetically or of finding substitutes.

VON SZELÉNYI (G.). **Ueber die Chalcididen-Gattung** *Pachyneuron* **Walk. (Hymen.).** [The Chalcidoid Genus *Pachyneuron*, Wlk.]—*Zbl. ges. Forstw.* **68** pt. 4 pp. 93–105, 44 refs. Vienna, 1942.

Redescriptions are given of the Pteromalids, *Pachyneuron pruni*, Wlk., which was bred, probably as a hyperparasite, together with *Monodontomerus* spp. and *Amblymerus mediterraneus*, Mayr, from pupae of *Tortrix* (*Cacoecia*) *murinana*, Hb., in Moravia (Czechoslovakia), and *P. grande*, Thoms., which was reared together with *Leucopis silesiaca*, Egg., on which it was probably parasitic, from *Eriopeltis festucae*, Boy., in Hungary, followed by a key to some of the Palaearctic species of *Pachyneuron* and a list showing the hosts of nine of them.

Papers noticed by Title only.

FERRIS (G. F.). **Atlas of the Scale Insects of North America. Series IV.**—Demy 4to planographed. Nos. SIV-2c, 385–444 [130 pp., 48 pls.] ; No. SIV-445, 11 pp. (**Supplementary Notes**) ; SIV-446, 67 pp., 3 pls. (**Classification and Keys to the Groups and Species** [of Diaspididae]) ; SIV-447, 4 pp. (**Epilogue**) ; SIV-448, 7 pp. (**General Index Series I–IV**). Stanford Univ. Pr., Calif. ; London, H. Milford, 1942. [*Cf. R.A.E.*, A **25** 595 ; **30** 152.]

YUST (H. R.). **A morphological Difference** [rostralis length] **between the California Red Scale** [*Aonidiella aurantii*, Mask.] **and the Yellow Scale** [*A. citrina*, Coq.].—*J. econ. Ent.* **34** no. 6 pp. 785–787, 4 refs. Menasha, Wis., 1941.

BEALL (G.). **The Transformation of Data from entomological Field Experiments so that the Analysis of Variance becomes applicable.**—*Biometrika* **32** pt. 3–4 pp. 243–262, 3 figs., 14 refs. London, 1942.

GÄBLER (H.). **Die wichtigsten forstentomologischen Arbeiten aus den Jahren 1939–1941.** [The more important Papers on Forest Entomology published in 1939–1941 (an annotated list of titles, almost exclusively German).]—*Tharandt. forstl. Jb.* **93** pt. 3–4 pp. 202–218. Berlin, 1942.

NOTICES.

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